SEPTEMBER 1958—SIXTY-FIFTH YEAR

Machinery

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1. **Single Cycle® Method**—exceptionally fast finishing.
2. **Cyclex® Method**—gears completed in one cut from the solid.
3. **Generated Gears and Pinions**—wide range of work accommodated.
4. **Unitool* Method**—minimum of cutters for prototype quantities.

The exceptional versatility of the No. 118 Hypoid Generator assures increased economy and production of Zerol®, spiral bevel and hypoid gears. Write for Bulletin.

*Trade Mark

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Builders of bevel gear machinery for over 90 years

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Machinery

SEPTEMBER 1958 VOL. 65 No. 1

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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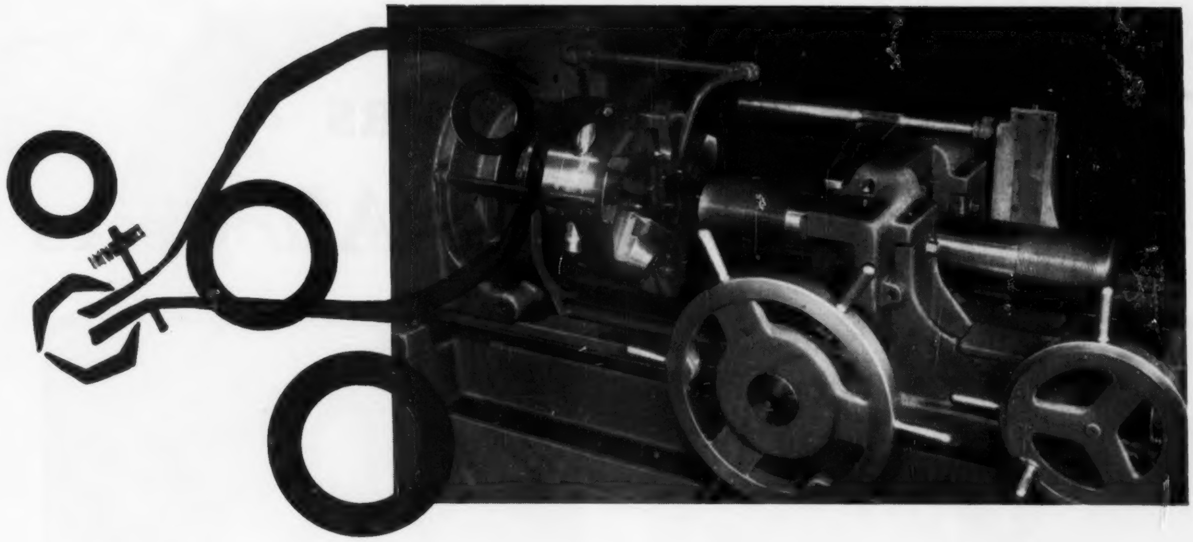
heavy duty machine

....*precision threading*

of large diameters



The cutting of large diameter threads to .003″ tolerance at the Kilbourn Engineering Co., Milwaukee, Wisconsin is an example of the heavy duty threading possible with the 48C LANDMACO Machine.

4140 steel heat-treated to 280-320 Brinnel is used in the production of 33½″ long double end studs used in high pressure vessels. 5¼″ 8 pitch U.N. threads are cut on both ends at 15-20 SFM by a 6″ 48C Single Spindle LANDMACO Machine equipped with lead screw feed, automatic workstop, and a six-chaser 48R LANCO Heat Treated Die Head. The stud end has an 8″ thread length threaded to a pitch diameter tolerance of .003″. The nut end has a 6″ thread length threaded to a Class 2 fit.

This operation is an example of the ease with which LANDIS equipment can solve your most difficult threading problem. The heavy duty construction of both the machine and the die head plus the lead screw feed ensures threading to precision tolerances.

508C

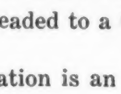
Futhermore, the LANDMACO Machine is equipped with hammer blow handwheel carriage fronts as standard equipment. This reduces operator fatigue, always a consideration when producing heavy, large diameter workpieces. Automatic work stops (as used in this operation) are available as auxiliary equipment to position the work for correct thread length and reduce pre-threading handling time. Available in double or single spindle models their ranges are: 2½″ to 6⅝″ bolt, and 2½″ to 6″ pipe. For more information ask for Bulletin H-45-2.

Perhaps there are threading operations in your plant that could be achieved at lower cost, with better quality thread, or greater versatility of production. LANDIS has had over 50 years' experience solving every type of threading problem. May we help with yours?

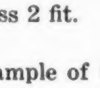
LANDIS *Machine* COMPANY

WAYNESBORO · PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

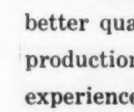


Threading Machines

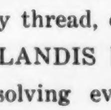


Die Heads—Rotary & Stationary

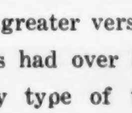
Taps—Collapsible & Solid Adjustable



Centerless Thread Grinding Machines



Thread Rolling Tools

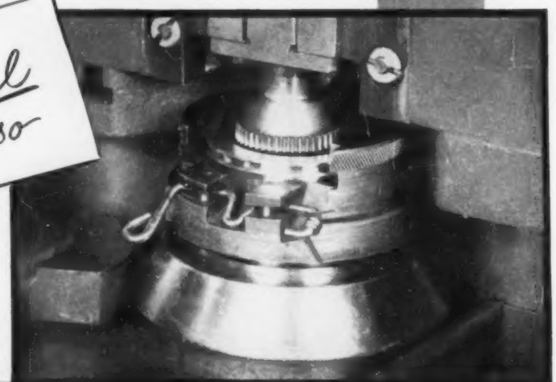


Thread Rolling Machines

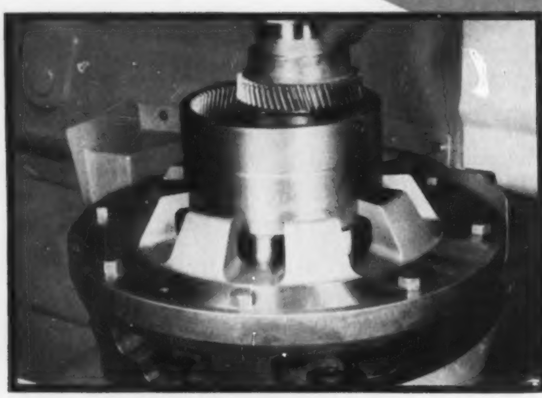
For more info on any products advertised this issue use card, page 201

FELLOWS GEAR SHAPERS

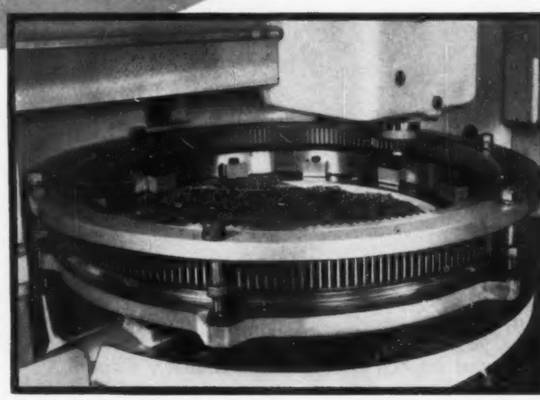
cut INTERNAL Gears



3" Fine-Pitch Gear Shaper cutting internal gear.



No. 10 Rotary Gear Shaper cutting internal helical.



36-Type Gear Shaper with special work-holding fixture.

120" Gear Shaper cutting light tank turret gear.

THE PRECISION LINE

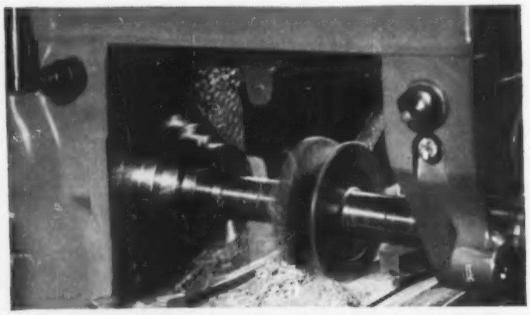
Variety plus

Cincinnati MIs are tops for practically every

Down milling holds thin parts down against the table or fixture; reduces in-process breakage of frail parts. Down milling is one of the many operations you can assign to CINCINNATI ML and MI Milling Machines, for all of them are equipped with Cincinnati's exclusive built-in backlash eliminator. While the table is feeding the work under or across the cutter this device automatically eliminates the backlash between the feed screw and nut; it automatically releases for all other conditions of table movement and adjustment. Other standard MI features to help you do a better job of variety milling include:

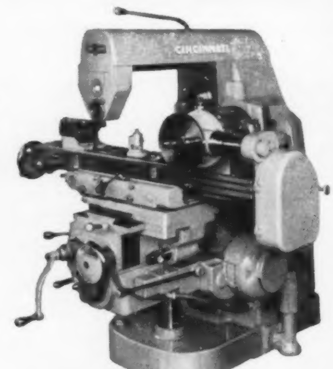
> **16 spindle speeds, 25 to 1500 rpm. 16 feeds, 1/4 to 30 ipm. Live power rapid traverse, 150 ipm. Single crank selection of spindle speeds and feeds. Dynapoise overarm smooths out the cutting action. Hand cranks automatically disengage; no spinning. Big selection of standard attachments.**

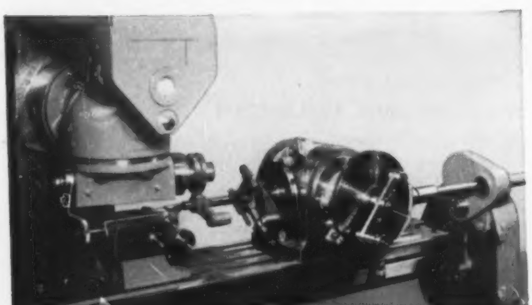
These and other Cincinnati advantages give CINCINNATI MLs and MIs top billing for 3 hp to 7½ hp milling operations. Get complete information by writing for a copy of catalog No. M-1995. Brief data in Sweet's Machine Tool File.



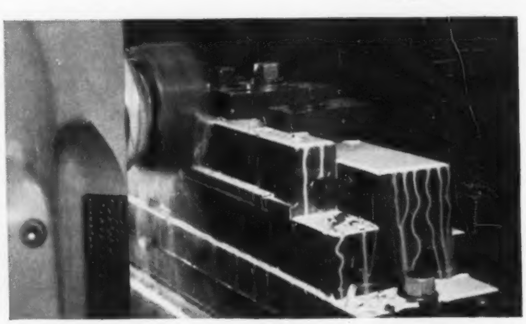
Aluminum and other non-ferrous metals requiring high cutting speeds can be efficiently milled on the MIs.

CINCINNATI No. 2 MI UNIVERSAL MILLING MACHINE
Catalog No. M-1995





Milling a helical tooth on the business end of a cast iron lever. The Universal Spiral Milling Attachment and Dividing Head are employed for this operation.



Taking a heavy cut in a steel vise jaw. CINCINNATI MI Milling Machines are constructed to assure the use of full motor hp at the cutter.

CINCINNATI® Knee Type Milling Machines • Bed Type Milling Machines

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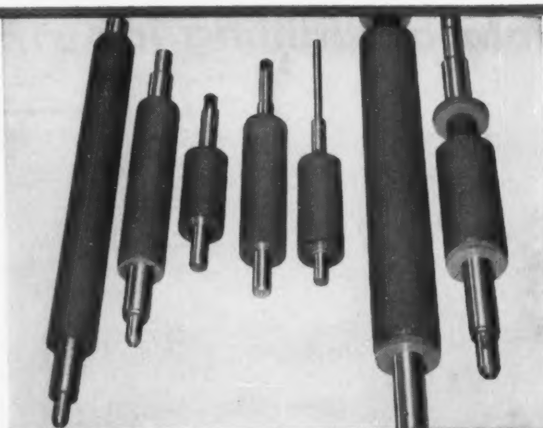
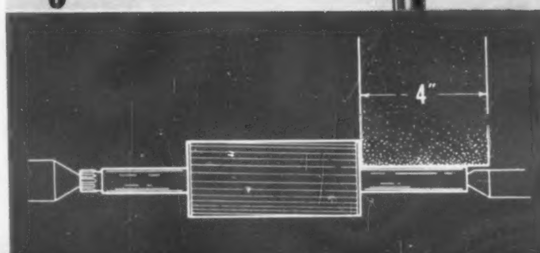
Infeed grinding with wide wheel raises

Various lengths and diameters of rotor shafts ground in small lots on new Landis grinder

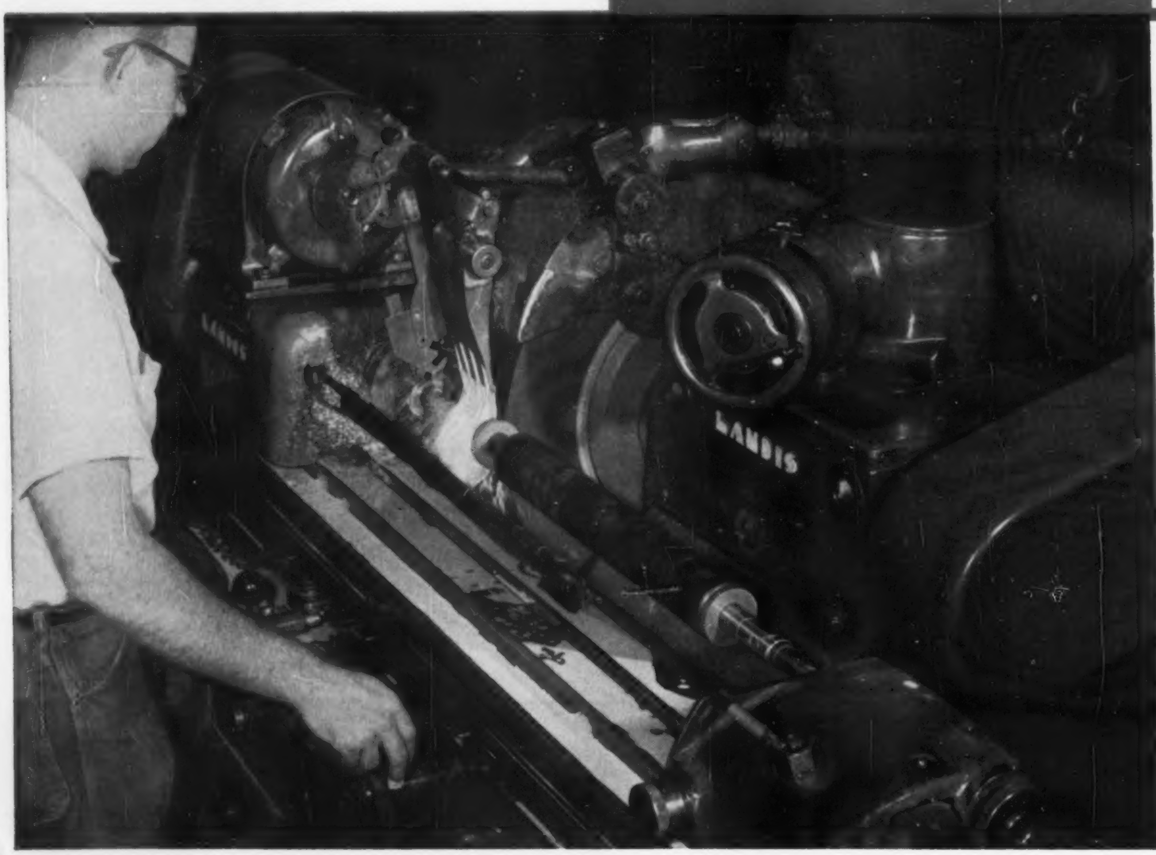


production data

Operation:	Infeed grinding journal diameters of assembled rotors
Machine:	Lanais 6" x 30" Type CH Plain Grinder with 4" wide wheel
Production:	25 to 46 parts per hour depending on size
Material:	304 Free Machining Stainless Steel
Stock removal:	.012"-.015"
Tolerances:	Bearings—.0002" with 12 RMS finish Other diameters—.0005" with 12-15 RMS finish



The accuracy of this Landis Plain Grinder minimizes rejects of costly rotor shafts. Lowers unit cost and maintains consistent high quality.



production over former traverse grinding

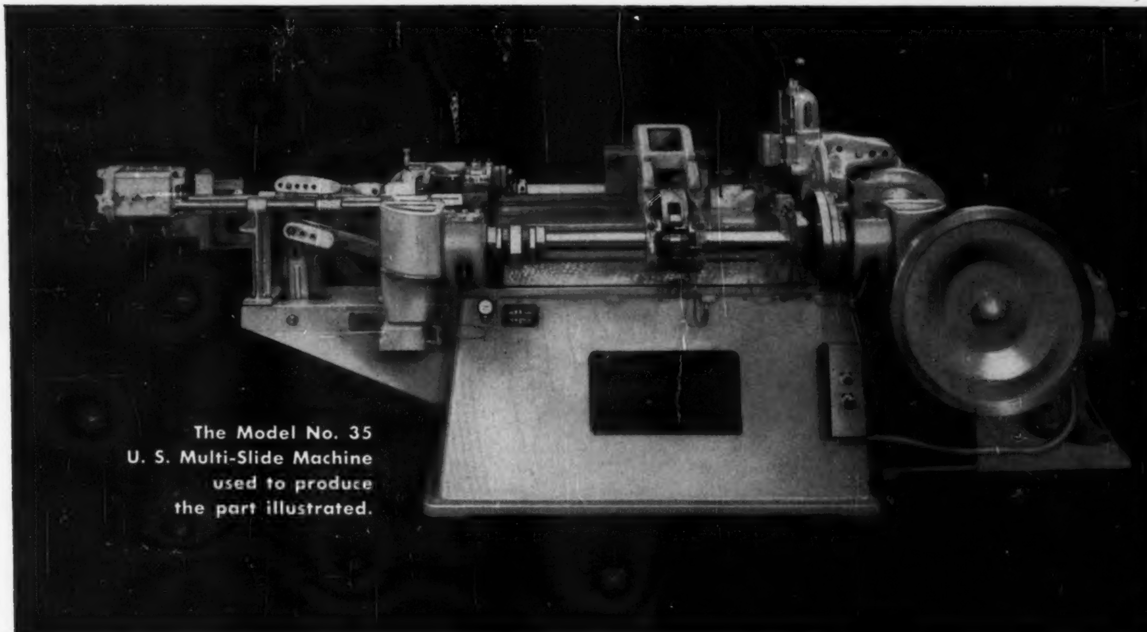
Coolant flow is stopped to show how footstock half center is used to grind short diameters with the 4''wide wheel.

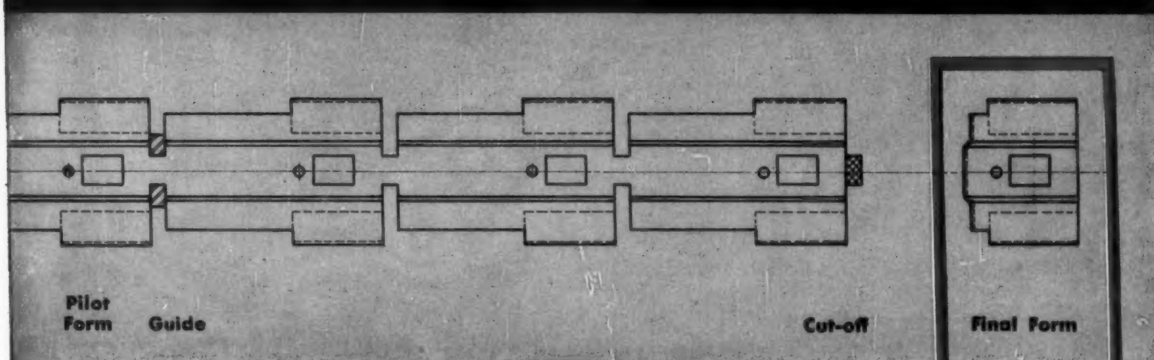
Automatic wheel feed permits operator to dog the next workpiece while one is being ground.

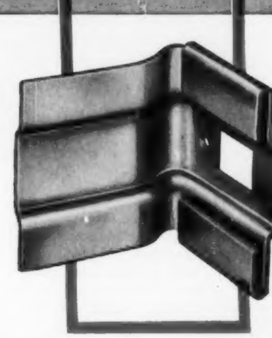
LANDIS

precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA







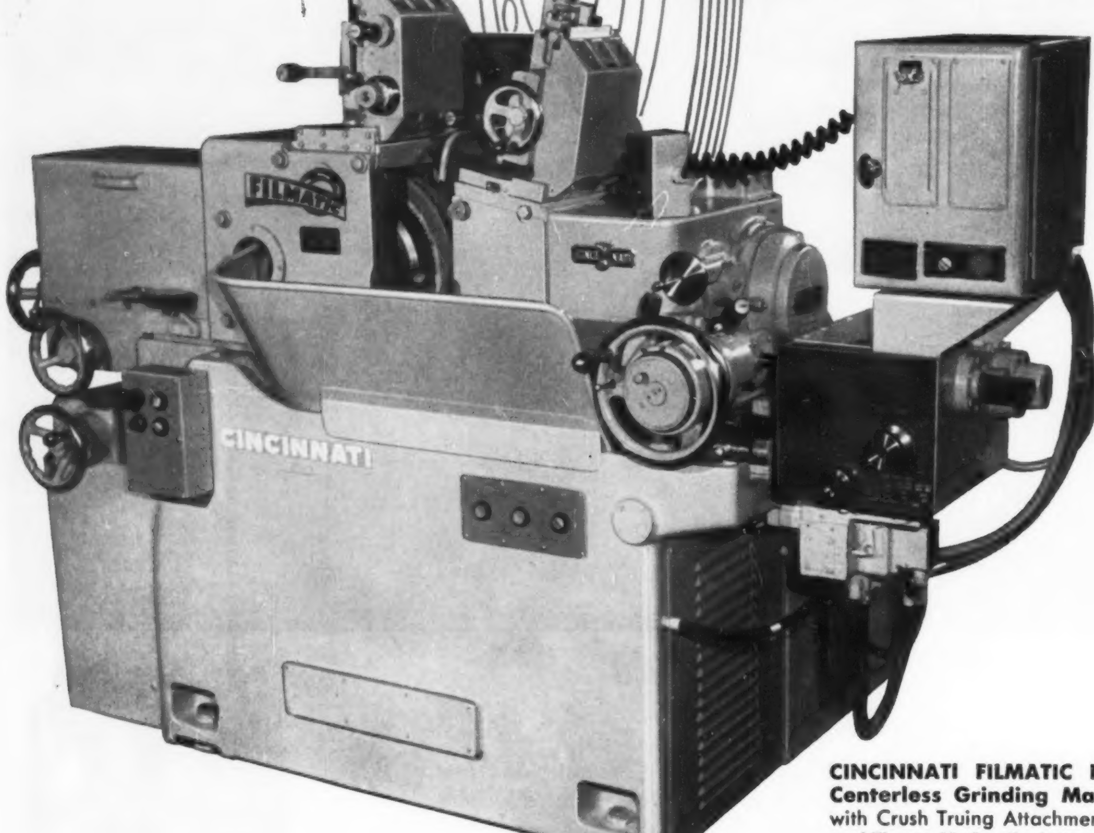
designed for the economical production of stampings. They are adaptable to the manufacture of wire parts as well as stampings from flat coil stock. In some instances more than one strip can be fed into a U. S. Multi-Slide for processing and completing an assembly. Prefabricated parts can be hoppered, positioned and assembled to the stampings being made while still in the machine. It is because of this versatility that the use of U. S. Multi-Slide Machines can considerably lower your component costs.

For the economical production of stampings—write for your copy of the U. S. Multi-Slide Bulletin No. 15-M—or send us your part drawings or samples for our recommendation.

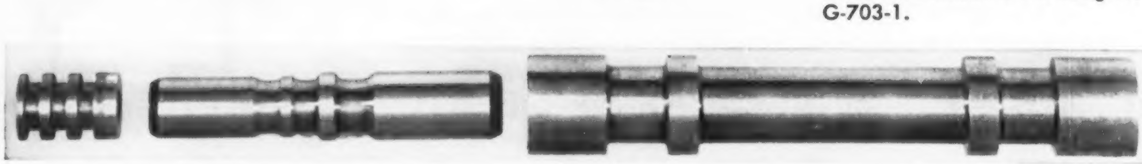
U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

CINCINNATI gives you a New Concept

CRUSH



CINCINNATI FILMATIC No. 1 Centerless Grinding Machine, with Crush Truing Attachment *(left)* and Electro-Hydraulic Automatic In-feed Attachment. Catalog No. G-703-1.



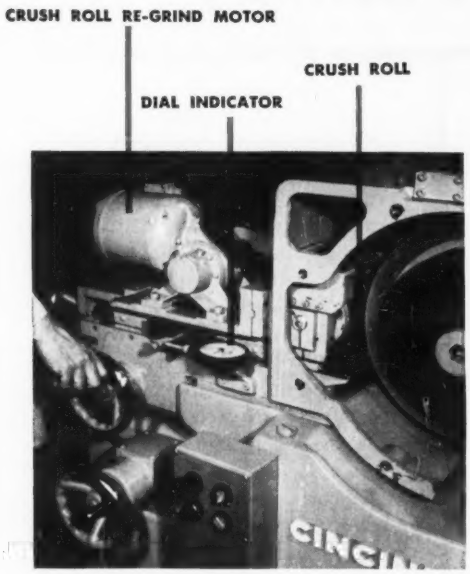
Crush form ground parts, produced on a CINCINNATI FILMATIC No. 1 Centerless. Notice the sharp bottom corners and accurate blended radii . . . they're easy to obtain with Cincinnati Crush Truing equipment. Center part is ground in one cut, removing .015" on dia., production 250 per hour.

CINCINNATI®

CENTERTYPE GRINDING MACHINES • CENTERLESS GRINDING
ROLL GRINDING MACHINES • SURFACE GRINDING MACHINES •

in Centerless Form Grinding with

TRUED WHEELS



Crush Truing unit, with cover removed, mounted on CINCINNATI FILMATIC No. 1 Centerless Grinder.

CINCINNATI

New methods are always enhanced by the latest design equipment. Take centerless form grinding with crush trued wheels, for example. Cincinnati has developed a new, highly proficient Crush Truing unit for CINCINNATI FILMATIC Nos. 1 and 2 Centerless Grinding Machines. It incorporates several new ideas in wheel crushing which contribute to the end result of precision form grinding at the lowest possible cost.

Exceptional rigidity for the entire crushing system is assured by Cincinnati's bed-mounted spindle construction.

Minimum setup time. Crushing rolls are cartridge mounted and easily interchanged. Lateral adjustment provided for positioning.

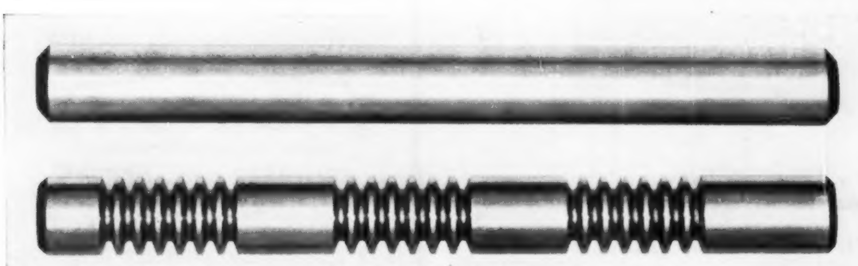
Dial indicator provides visible check on crushing feed rate. Handwheel for rapid positioning.

Long crushing roll life. Rolls are 5½" diameter for No. 1 Centerless and 6" diameter for No. 2 Centerless. Separate motor drive to re-grind worn rolls in position.

Correct grinding wheel speed for crushing, through an auxiliary motor drive and overriding clutch.

Profile diamond wheel truing unit included for "roughing out" the desired shape in the wheel.

Low-cost crush form grinding on a CINCINNATI Centerless is augmented by many Cincinnati exclusives such as FILMATIC grinding wheel spindle bearings and the world's most experienced Centerless Grinding Engineering Service. Look into this method of precision grinding as a new production idea. You can start by writing for Cincinnati Crush Truing brochure No. G-706.



Rack teeth crush form ground from the solid in one operation on a CINCINNATI FILMATIC No. 2 Centerless. Major diameter .500", minor diameter .320" (.090" depth of cut). Before and after grinding illustrated.

MACHINES • MICRO-CENTRIC GRINDING MACHINES
CHUCKING GRINDERS • CENTERLESS LAPPING MACHINES

Grinding Machine Division
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

Now—FINISH FLAT

New Norton 6" x 18" Surface Grinder Ready For Immediate Delivery

You FINISH FLAT FASTER with the new Type S-3 hydraulic which is equally efficient for long production runs or a wide variety of toolroom grinding because of its new cost-cutting features. It produces plane surfaces smoothly — with automatic or manual cross feed and with such fast, cool-running action that it saves time and money on every job.

Ask your Norton Representative for the whole story. Or write us direct for Catalog 2128. And remember: only Norton Company offers you such long experience in both grinding machines and grinding wheels to bring the "Touch of Gold" that helps you produce more at lower cost. NORTON COMPANY, Machine Division, Worcester 6, Massachusetts.

Profit from these benefits

1. Get Jobs Done Fast and Cool — high table speed, *125 feet per minute, maximum.* **2. Handle Tall Work Pieces** — greater vertical capacity, *15"*. **3. Get Lasting Accuracy** with guide-rail cross slide construction. **4. Control Vertical Feed Accurately and Position Fast** with two-speed .0001" increment hand wheel. **5. Benefit from Better Sighting and Loading** due to contoured splash guards. **6. True Forms, Even on Worn Wheels** because of recessed wheel spindle housing.

To Economize, Modernize with NEW

NORTON

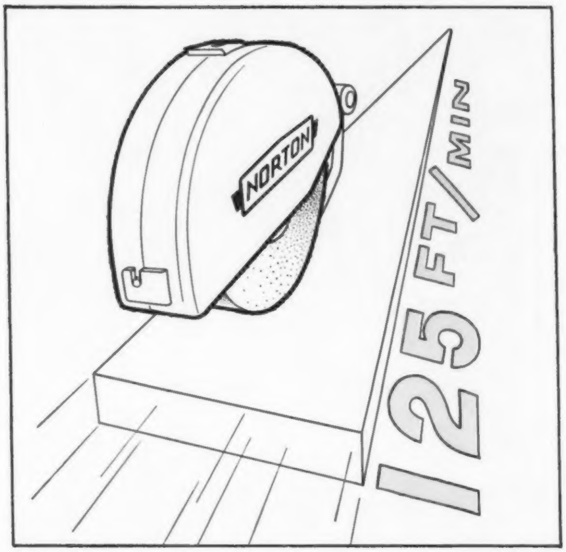
GRINDERS and LAPPERS

Making better products... to make your products better

NORTON PRODUCTS
Abrasives • Grinding Wheels • Grinding Machines
Refractories • Electrochemicals
BEHR-MANNING DIVISION
Coated Abrasives • Sharpening Stones
Pressure-Sensitive Tapes
District Offices
Worcester • Hartford • Cleveland • Chicago • Detroit
In Canada: J. H. Ryder Machinery Co., Ltd., Toronto 5

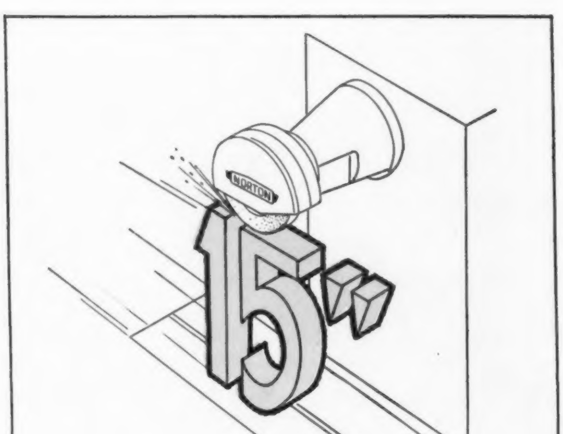
FASTER....

These and many other new features make this machine a "must" for your surface grinding jobs.

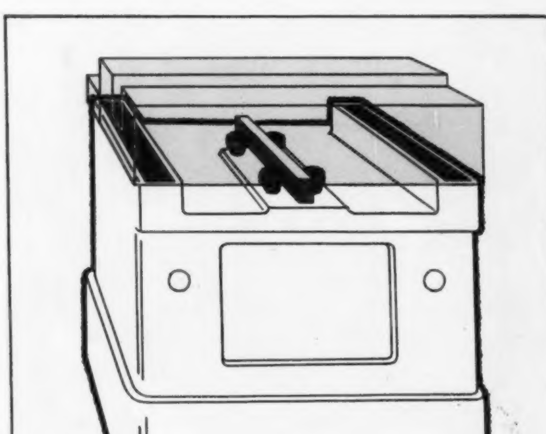


Finish flat faster, cut grinding time and increase production, with high table speed, 125 feet per minute.

Heat goes off in the chips, due to new, high table speed. This cooler grinding permits faster production on heat-sensitive metals.



Handle taller work pieces with high-grind wheel head construction. The vertical capacity from the table top to the bottom of standard full size 8" diameter grinding wheel is 15"



Widely spaced, flat ways and guide-rail cross slide design maintain cross feed accuracy, providing lastingly accurate grinding of shoulders or parallel surfaces.

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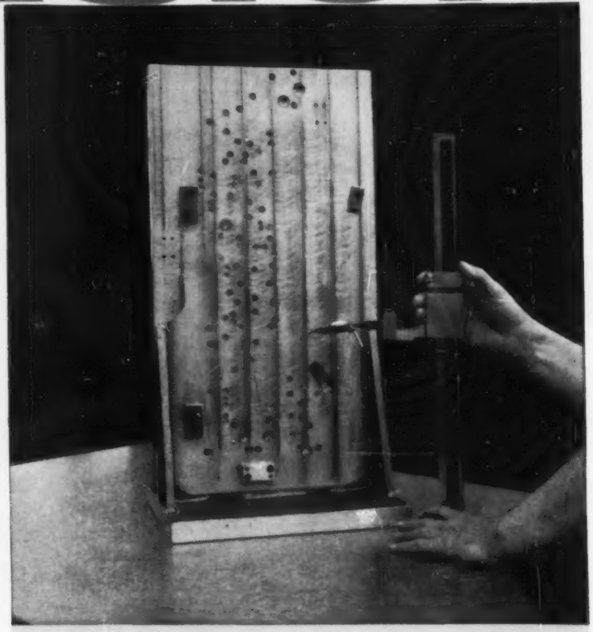
PRECISION



HOLES LOCATED TO ±.0001", FAST

with Fosdick Automatic Positioning and Direct Dimension Measuring. (Operator sets hole locations direct from blueprint on two direct-reading drum dials.) With B-F Spindle, tools are changed in less than 10 seconds, accurate to ± .0001" of original setting.

"THIS JOB WOULD TAKE 20% LONGER

on our other jig borer, but it couldn't be done with such accuracy. Wouldn't even attempt it without our Fosmatic!"

FOSMATIC JIG BORERS

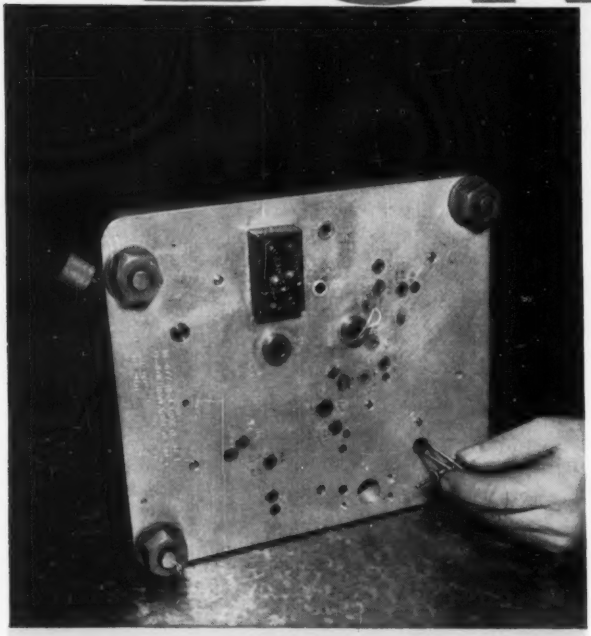
We asked Textile Machine Works, Reading, Pa., what specific advantages they gained with their new Fosmatic Jig Borer, and here's what they said:

"Time saving? It's hard to say. Might be 20% on one job, 40% on another. But those are just estimates. How can you compare apples and oranges? The Fosmatic and our other jig borer are worlds apart.

"The important thing is we meet all accuracy requirements *the first time* on our Fosmatic. Rejects are virtually a thing of the past. Moreover, we're doing work on our Fosmatic that we wouldn't even attempt on our other jig borer. The only accuracy problem

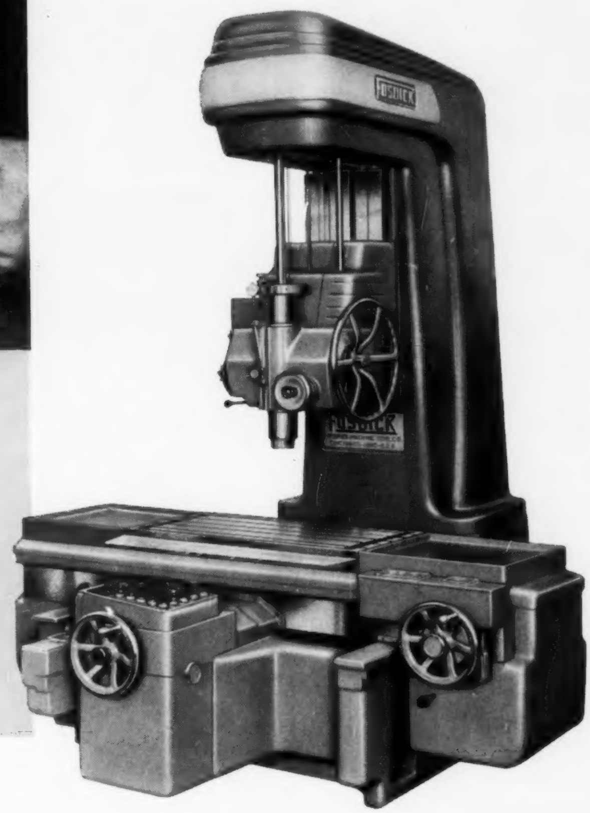
BORING

OF COMPLEX GAGES AND JIGS



"FOSMATIC SAVED US 2 HOURS

on this 8 hour job, but the accuracy we gained is even more important."



we have now is controlling the temperature of the workpiece!"

On Fosmatic Jig Borers, positioning accuracy depends upon highest quality gages, not upon screw-threads. This feature and Fosdick's unique anti-friction quill design assure dependable accuracy. Fosmatic Jig Borers bring you many important advances in boring technology including numerical control by punched cards or tape. Where progress has been so great, the obsolescence of your old machine may be more costly than you suspect. *Why not run a check?* Call your Fosdick Distributor or write us today.

Ask for Fosmatic Jig Borer Bulletin JB-M

Get a Proposal from

FOSDICK

THE FOSDICK MACHINE TOOL CO.
CINCINNATI 23, OHIO

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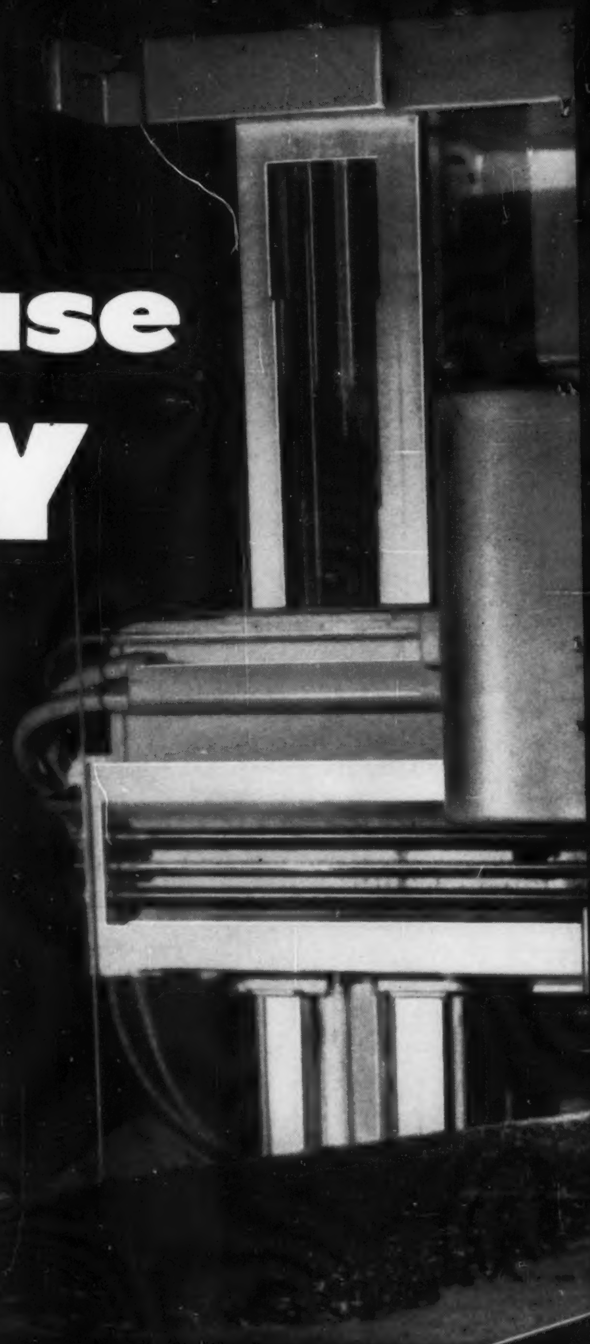
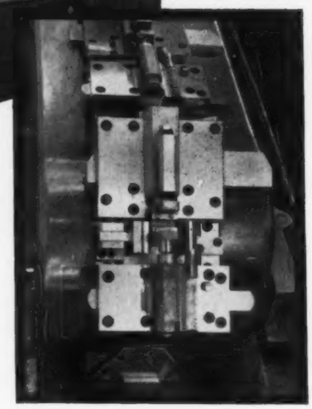



GRAY



Holding fixtures are designed for quick, convenient loading, with automatic clamping and unclamping.

LOWER COST . . . PER PIECE WITH SURFACE BROACHING OF SMALL PARTS

In many plants where large quantities of duplicate metal parts are being machined, substantial savings are being made through the adoption of surface broaching. Production is exceptionally high, close tolerances are maintained, and tool maintenance costs are much lower than with ordinary methods. Foote-Burt engineers, pioneers in this advanced machining method, have had a wide experience in applying surface broaching, in many fields.

THE FOOTE-BURT COMPANY
Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

ENGINEERED FOR PRODUCTION

Write for Circular No. 503

FOOTBURT

PIONEERS IN SURFACE BROACHING

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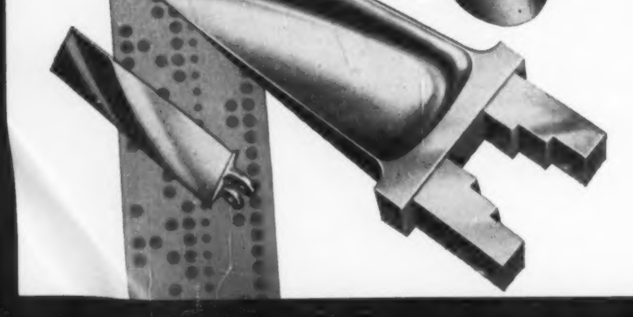


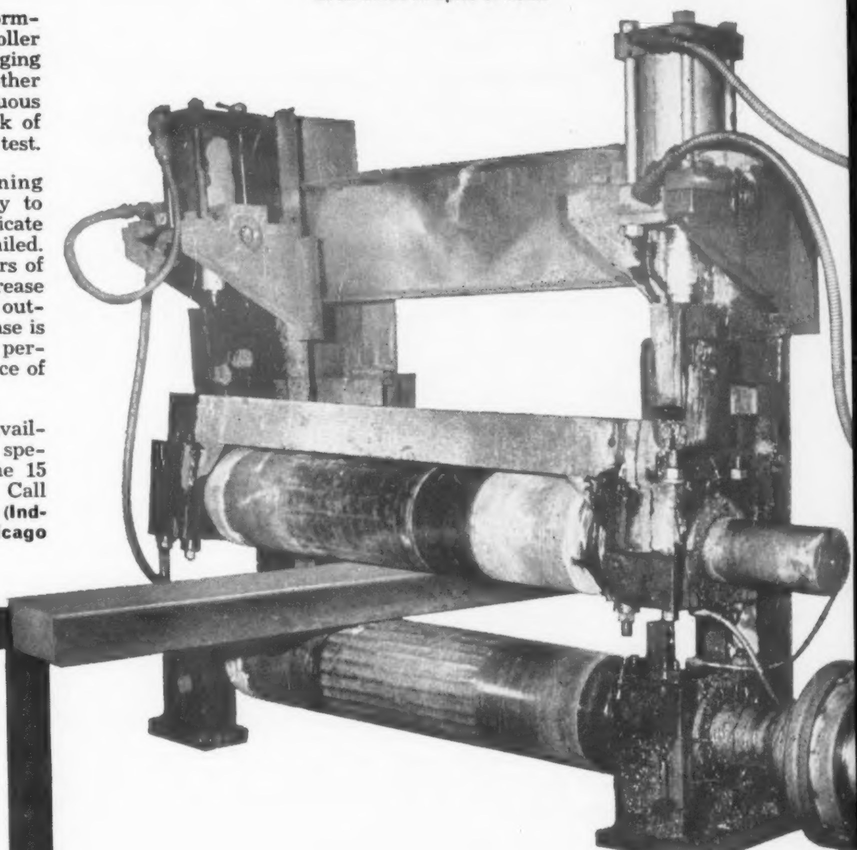
Bearings on the 46-inch blooming mill manipulator and side guard carrier had to be lubricated twice each eight-hour shift before Rykon Grease was used. The mill had to be shut down while the lubrication work was performed. Now with Rykon, the bearings are greased once each shift. Maintenance men find rollers and pins are still well lubricated. The rollers are subject to almost constant heat and water washing. Steel blooms heated to approximately 2300° F. are just 18 inches away from the Rykon lubricated bearings. The lubricating properties of the grease are unaffected by the heat.

RYKON Grease delivers similar performance results elsewhere in the plant. In roller bearings on the reheating furnace charging tables, in pinch roll bearings and in other trouble spots, where heat and continuous water washing would make short work of other greases, Rykon stands up to the test.

A unique nonsoap, organic thickening agent gives Rykon Grease the ability to provide lubrication in tough-to-lubricate spots long after other greases have failed. This thickener is the result of five years of research effort by a Standard Oil grease research team working to develop an outstanding industrial grease. Rykon Grease is a true multipurpose grease capable of performing all lubrication jobs on one piece of equipment or often in an entire plant.

More facts about Rykon Grease are available from the Standard Oil lubrication specialist that is near you in any of the 15 Midwest and Rocky Mountain states. Call him. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Bloom in the pinch roll. A 2300° F. bloom goes through while water washes continuously. RYKON Grease keeps this equipment lubricated at all times in spite of heat.



Quick facts about
RYKON Grease

- Stable at high temperatures. At sustained high temperatures RYKON Grease remains soft and grease-like.
- Resistant to water washing.
- Mechanically stable. Minimum change in consistency in service.
- Resistant to oxidation. Thickener acts as an inhibitor.
- Exceptional rust preventive properties.

You expect more from STANDARD and get it!

Lubrication time cut. Mill feeder pinch roll bearings formerly lubricated twice each eight hours. Now with RYKON Grease lubrication is needed only once each shift. Elbert Dean, Northwestern Steel lubrication engineer, and Standard Oil lubrication specialist, Charles Daub, inspect bearings. Counseling people who have lubrication jobs like this is work for which Chuck Daub is well-qualified. Chuck has 12 years' experience in lubrication technical service work. He has an engineering degree from Illinois Institute of Technology and has completed the fifteen week Standard Oil Sales Engineering School course.

No lathe development in recent years has equaled template controlled turning for substantial cost reduction. Its advantages, when performed the Monarch "Air-Gage Tracer" way, are many. This duplicating method:

- Always outproduces a manually operated machine; in some instances as much as 8 to 10 times.
- Provides automatic sizing, thereby reducing spoiled work to the absolute minimum.
- Imparts a smooth, stepless finish on any combination of cuts, whether turning, facing or boring.
- Often halves amount of stock left for grinding; sometimes eliminates grinding and polishing operations.
- On most work, reproduces accuracy of template within ±.001".
- Eliminates the need for expensive form tools and the cost of multiple tool setups.
- Allows a complete setup change in as little as 15 to 20 minutes; tool change in 1 minute.

Write for complete descriptive booklet No. 2608. It contains dozens of typical job examples . . . ***The Monarch Machine Tool Company, Sidney, Ohio.***

Exclusive Features of the "Air-Gage Tracer"

1 The only lathe duplicator which utilizes the combination of air-hydraulic control. That's the secret of its super-accuracy.

2 The air circuit is an open loop servo system which provides air-gaging and multiplies both force and motion.

3 It's the simplest and most trouble-free of all lathe duplicating methods. Tracer head maintenance is never a costly problem.

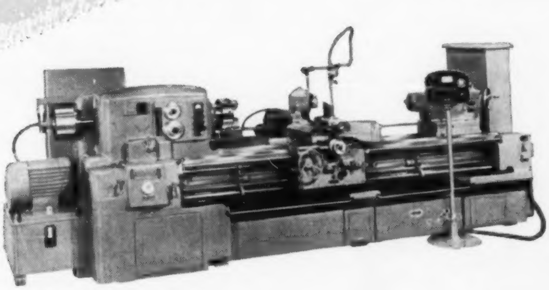
4 Stylus pressure against template is only 5 to 6 ounces, practically eliminating template wear.

5 Either a flat or a round template may be used. Excepting on very small lot, non-repetitive runs, the flat template has many advantages. Never is it necessary to use a large, bulky round template so that it can be indexed periodically due to excessive wear from high stylus pressure.

6 Available both in a rigid and swiveling type, the latter of which may be used at any setting between 45° and 90°. Universal nature of swiveling type a "must" for top production on many complex facing and boring operations.

7 The only lathe duplicator offered optionally with full automatic cycling and potentiometer feed control.

8 Backed by almost 30 years' experience in the field of tracer controlled turning. Thousands of "Air-Gage Tracer" lathes attest to its acceptance by industry everywhere.



Above is a Monarch Series 62 Preselector Dyna-Shift Lathe with "Air-Gage Tracer" and auto cycle unit. This duplicating means may be factory applied to all lathes in the Monarch line. They may be converted to conventional manual operation merely by the flick of one lever. The "Air-Gage Tracer" is also the heart of such Monarch production lathes as the Mona-Matic, Hydra-Slide and Right Angle.

Monarch

ACCURACY • ECONOMY • LONG LIFE

TURNING MACHINES

FOR A GOOD TURN FASTER . . . TURN TO MONARCH

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Weld questionable steels with . . .

JETWELD LH-70

- *Outstanding overhead and out-of-position operation*
- *High physical properties*
- *Fast, easy iron powder action*

Jetweld LH-70 operates overhead with the smooth, fast action—and has the high physical properties of a low hydrogen rod.

Produces crack-free welds on heavy plate with a minimum of stress relieving. Reduces the need for preheat on medium carbon steels—makes porosity free welds on sulphur bearing steel.

A.W.S. Classification E-6016.

Look for the three dots • • • symbol of Lincoln quality. Weldirectory of Lincoln mild steel electrodes Bulletin 7000.1 sent free on request.

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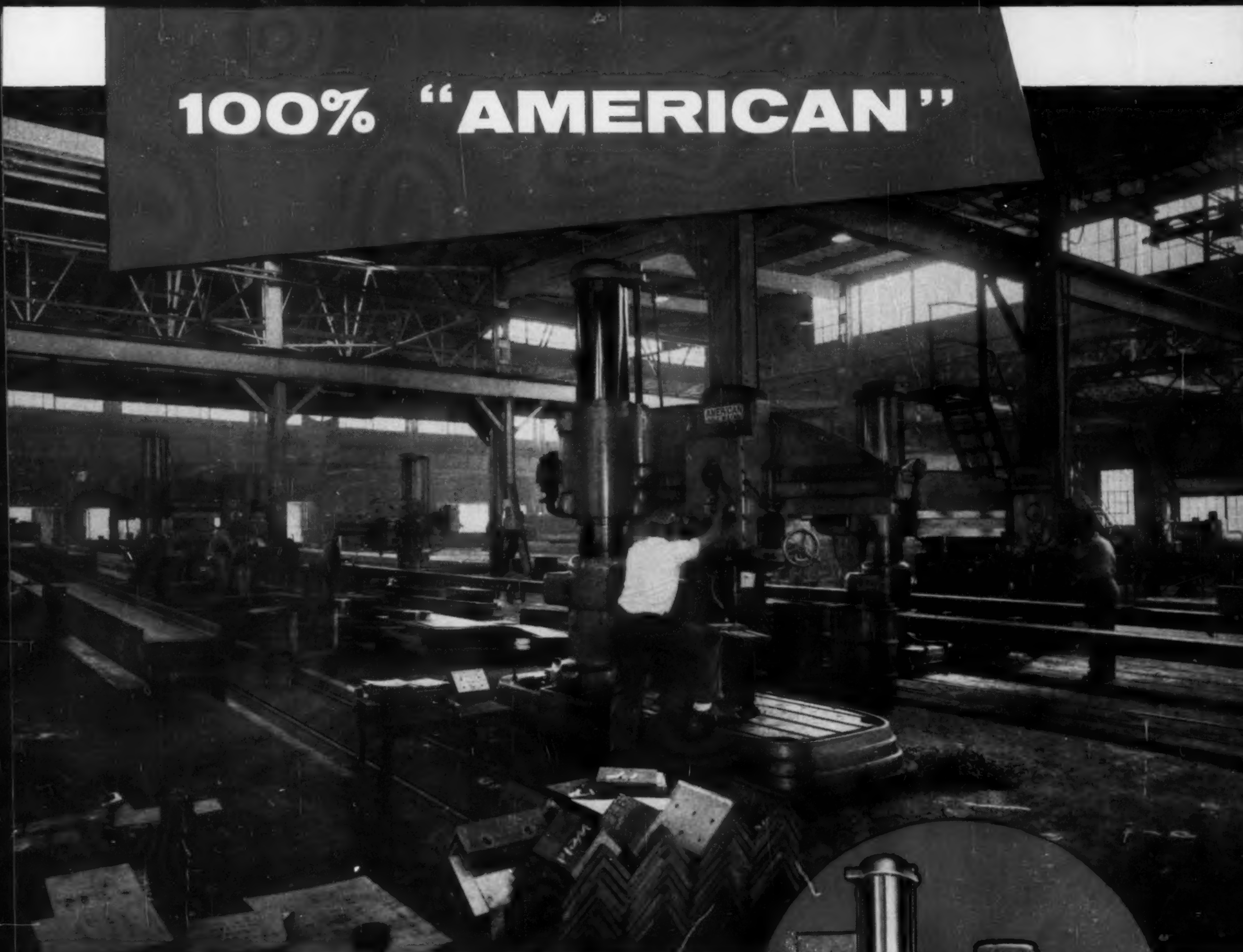
100% "AMERICAN"



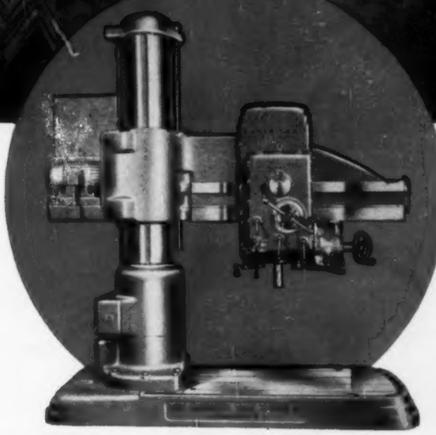
The Stupp Bros. Bridge and Iron Company of St. Louis, Missouri, known the country over as one of the leading structural steel fabricators, use "AMERICAN" Radial Drills exclusively.

Mr. Erwin P. Stupp, President, gives as his reasons for his continuous selection of "AMERICAN"—

- EASE OF HANDLING
- RIGIDITY
- FAST MANIPULATION
- LOW MAINTENANCE

These factors combined with the extra power offered by "AMERICAN" Hole Wizard Radials guarantee a handsome return upon the user's investment.

The half dozen "AMERICAN" Radials installed during the past 10 years are conclusive testimony to the satisfactory service afforded by these modern drilling, boring and tapping machines.



PLUS FEATURES

- Centralized Control.
- Lightning-fast Direct Reading Speed Change.
- Nitrided Spindle and Sleeve—practically wear proof.
- Timken mounted column unit defies deflection.
- Raybestos covered, spring steel tapping attachment friction bands, quick acting, wear proof, permitting 40% speed-up for spindle reverse.

Send for bulletin No. 328

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

"Now, with our Schiess vertical turret lathe
one 8-hour shift does the work of three!"

says Arnold R. Kline, plant manager, O.K. Rubber, Inc., Littleton, Colo.

Schiess 13EK-150 Vertical Turret Lathe turning a 33 in. "Nu-Matic" tire mold sidewall plate, made of #12 cast aluminum.

"Production on sidewall tire molds jumped 300%. Material spoilage was reduced 50 to 60%. Per unit cost dropped 60%. And we have a better machined end product!" That's the way Arnold Kline wraps up the production story at O.K. Rubber, since he installed this Schiess machine.

He continues: "We've got the Schiess mill doing everything from boring 1¼ in. holes to turning plates 56 in. in diameter. We thought we'd need a custom-made mill to do our kind of work. We don't think that way any more."

"And frankly, we were amazed at the price—30 to 40% lower than we expected!"

No costly training time was needed. Skilled machinists were checked out on the mill in just a few hours. Operators particularly liked the horizontal head, the rapid traverse lever, the cross-rail mechanical controls. All contributing to greater accuracy . . . better finish . . . less machining time.

Get to know this and other products of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess engineer will be happy to help you select the proper tool for your production needs. Write today.

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Genuine ALLENs for your king-size holding jobs now available from stock!

1¼" and 1½" sizes are standard

These applications show you the great variety of holding jobs for which designers and engineers are specifying these rugged king-size Allen Hex-Socket Cap Screws. They're genuine Allens, from their heads to their Leader Points. Pressur-formd, to preserve the long fibers uncut throughout their lengths. Highly accurate threads. Leader Points, of course—for fast, true starting. 1¼" and 1½" diameters available immediately from stock—larger diameters are available on special order.

PHOTO: THE OILGEAR CO.

King-size Allen Hex-Socket Cap Screws are used to secure the flanges in this big 12-inch 3000 psi Oilgear Surge Valve.

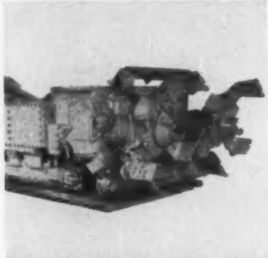


PHOTO: GOODMAN MFG. CO.

King-size Allens secure cutter arms, tilting arms, and elevating cylinders in this massive Goodman Continuous Mining Machine.

PHOTO: SODERHAMN MACHINE MFG. CO.

King-size Allen Cap Screws securely clamp the knives of this large and unusual machine that debarks whole trees.

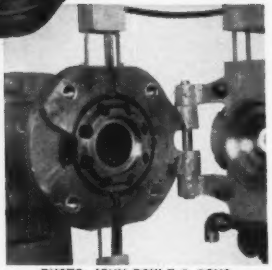


PHOTO: JOHN ROYLE & SONS

King-size Allens in the side-delivery Extruding Head of this Royle machine for application of rubber or plastic in solution.

The cost of Allen Hex-Socket Cap Screws is only a minor fraction of your assembly costs . . . be sure you're getting the timesaving, cost saving advantages of genuine Allens!

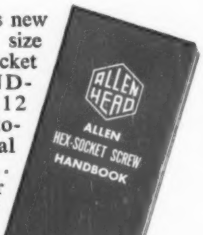
ALLEN GRIP HEAD CAP SCREWS—known throughout industry as fastest, easiest starting, firmest holding. Standard sizes from No. 0 to 1½" diameters.

ALLEN FLAT HEAD CAP SCREWS—for streamlined, flush-fastening of thin plates, moldings, etc. Standard sizes from No. 4 through ¾" diameters.

ALLEN BUTTON HEAD CAP SCREWS—for streamlined, snag-free, unbroken surfaces where countersinking is impractical. Standard sizes from No. 4 through ⅝" diameters.

ALLEN STAINLESS STEEL CAP SCREWS—for applications where bright finish, or rust and corrosion resistance is essential. Standard sizes from No. 0 to ⅝" diameters.

FREE! . . . this new "vest-pocket" size Allen Hex-Socket Screw HANDBOOK . . . 112 pages of up-to-date technical information ... Send for your free copy today.



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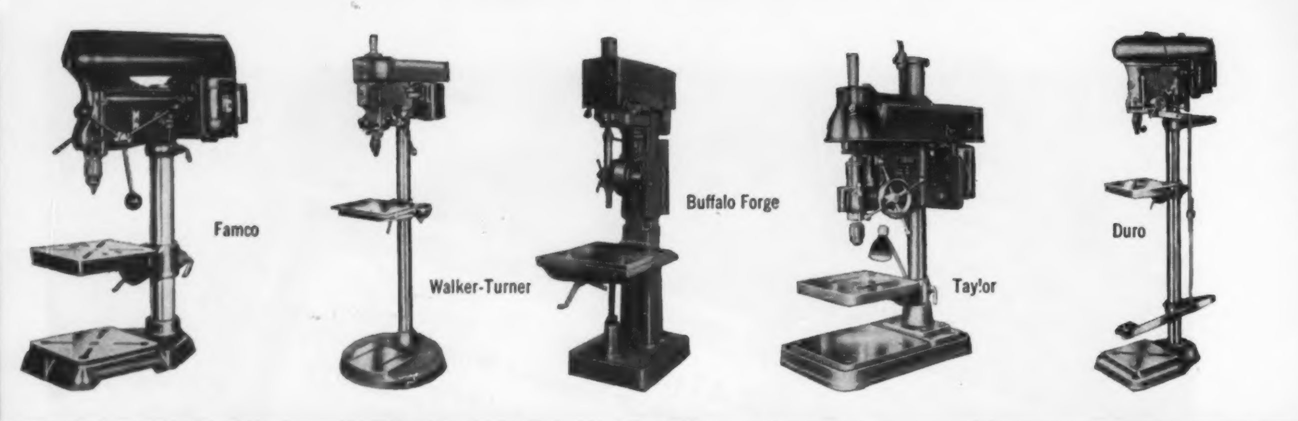
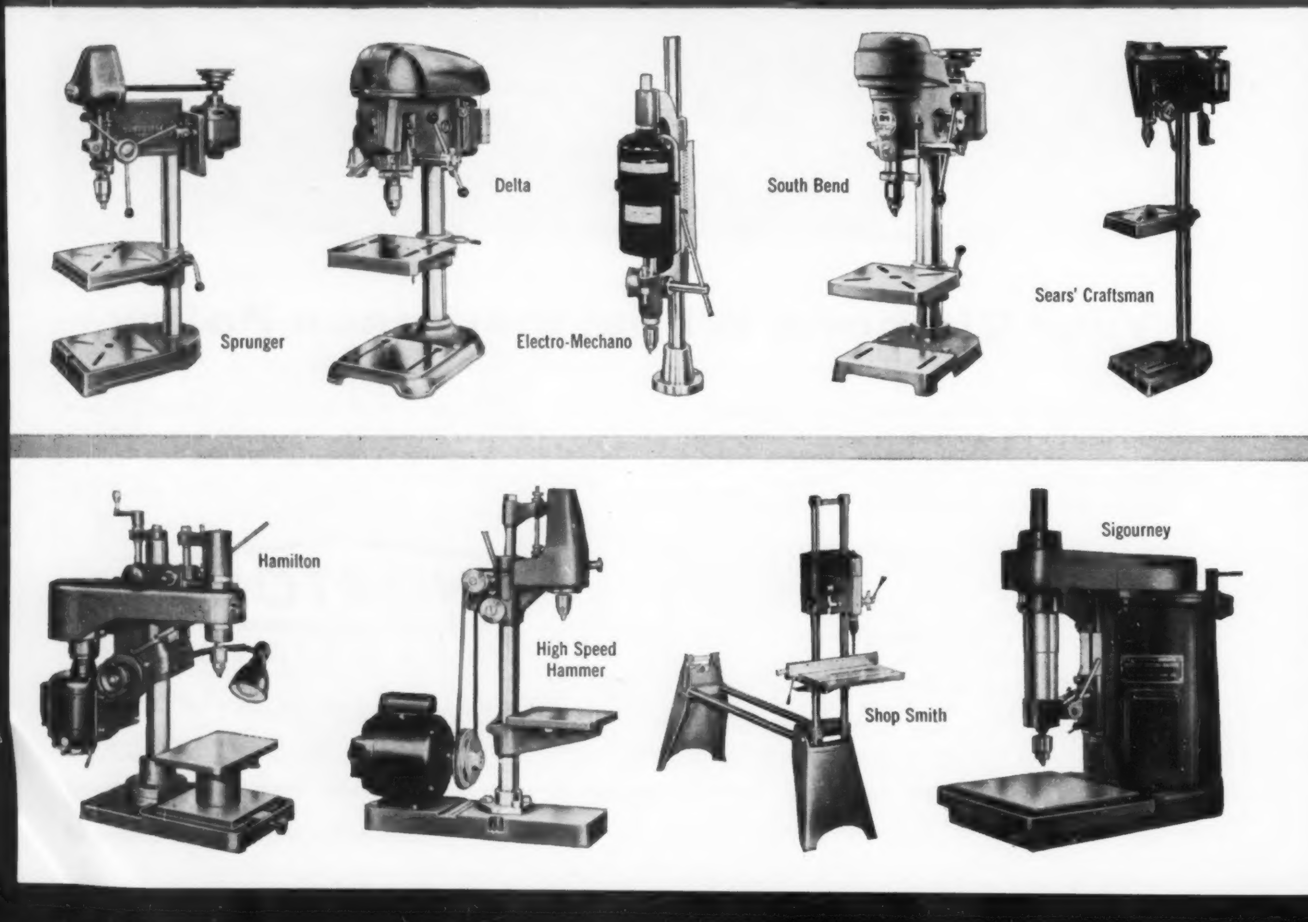


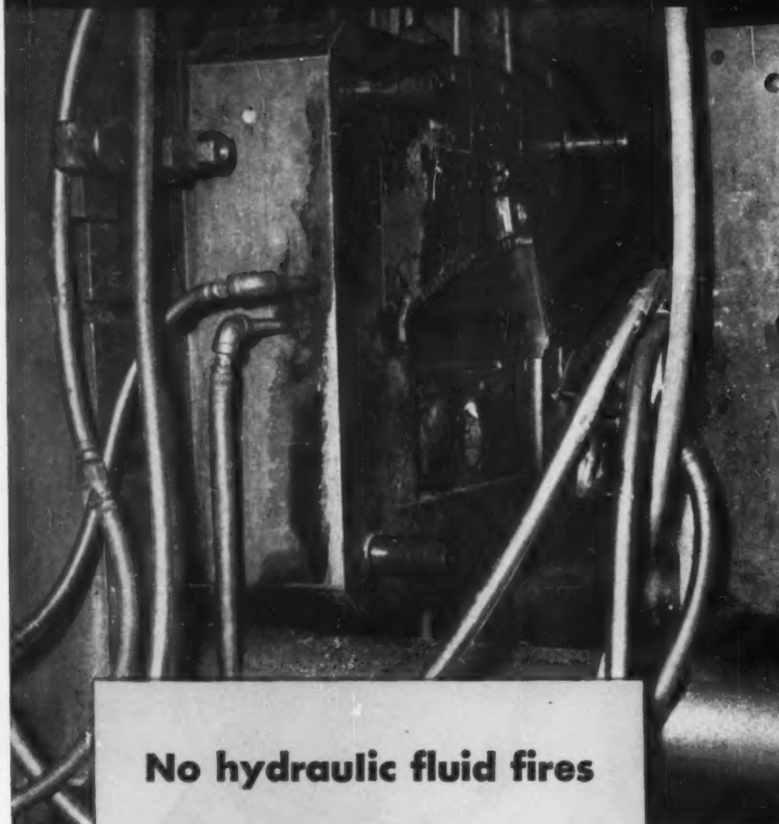
DRILL PRESS MANUFACTURERS

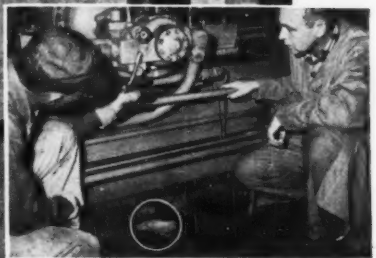
put their money on

JACOBS CHUCKS

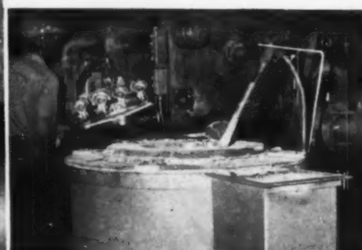


"For 3 solid years—





Irus Fluid's distinctive yellow color makes it easy to spot and trace leaks.



Complexity of lines (left) and pots of molten metals (above) represent the type of fire hazards requiring Shell Irus Fluid 902.

No hydraulic fluid fires

No worker injury

No equipment damage —since we switched over to

SHELL IRUS FLUID 902"

says Ernie Ike, Plant Superintendent
Western Die Casting Co., Emeryville, Calif.

According to Mr. Ike, these results are directly due to the switch-over in 1955 from conventional hydraulic fluids to Shell Irus Fluid 902.

Irus® Fluid 902 is a special combination of petroleum oils mixed with water and emulsifying agents. Its fire resistance is achieved through the relatively high water content. Irus snuffs out fire, *under plant conditions.*

Another important advantage of Irus Fluid 902 is its low cost. Plant operators now using Irus have discovered that Irus Fluid costs up to one-third less than other fire-resistant fluids . . . yet is comparable in performance in every practical respect.

If the hydraulic equipment in your plant is exposed to fire hazards, let a Shell Industrial Representative show you the advantages of Irus Fluid 902. Write Shell Oil Company, 50 West 50th St., New York 20, N. Y. or 100 Bush St., San Francisco 6, Calif.

SHELL IRUS FLUID 902

a low-cost, fire-resistant hydraulic fluid

SHELL

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The Cleveland Twist Drill Co., with its more than 80 years of experience and "know how", is constantly working on new developments and improvements to keep pace with modern metalworking techniques. Every tool, designed and manufactured to the same high standards which have made the familiar ◈ trademark famous, will give you *more production per dollar.* For complete information, contact our nearest Stockroom or . . .

TELEPHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR

MO-MAX T-Shaped Ground Cut-off Blades

These improved blades are available in MO-MAX or MO-MAX COBALT High Speed Steels, heat treated to produce *more cuts per grind.* Head and body are ground to close tolerances, resulting in accurate uniformity and reduced set-up time.

Split Sleeves for Straight Shank Drills

The hole in these high quality sleeves is concentric with the body, assuring less run-out at the drill point, longer tool life and better holes. Used with tanged straight shank drills, you get *more flute length at lower cost.*

MO-MAX Hardened and Ground Drill Blanks

New Drill Blanks—hardened all over, and ground without back taper. Wire gauge, letter and fraction sizes, No. 80 to ½ inch, singly or in sets. Useful for making punches, tool bits, countersinks, boring tools, burring tools, etc.

Carbide Die Drills for Hard Steel

For drilling hardened steel in the range of 48 to 65 Rockwell C. Holes may be drilled without annealing or appreciably changing the structure of the material. Can be used with or without coolant.

END MILLS

Hy-Spiral Two Flute Double-end

Proper rake angles and cutting edge relief assure efficient milling in non-ferrous materials and in the harder alloys. Positive chip ejection . . . no build-up on the cutting face. Especially economical on long runs.

Heavy Duty with Duo-Drive Shanks

The 2 inch DUO-DRIVE shank fits the conventional two-set-screw-drive holder as well as the bayonet-lock type of holder. Heavy web construction, accurate machine-ground end-tooth notching and special surface treatment.

Two Flute Extra Long Ball-nose

They have the extra length for milling fillets and pockets which cannot ordinarily be reached by the conventional length end mills. With these center cutting end mills, the initial hole may be "drilled".

Two Flute Double-end Ball-nose

Machine-ground notch and ball end assure the easy removal of chips in deep slotting and pocketing operations, with the resultant savings realized in more material milled per grind. Economical on production runs.

500 SERIES Four Flute Center-cutting

Now you can get the plunge cutting ability of a two or three flute end mill with the finer finishes and better size control that are possible with a four flute end mill. Made with square nose or ball nose.

THE CLEVELAND TWIST DRILL CO.

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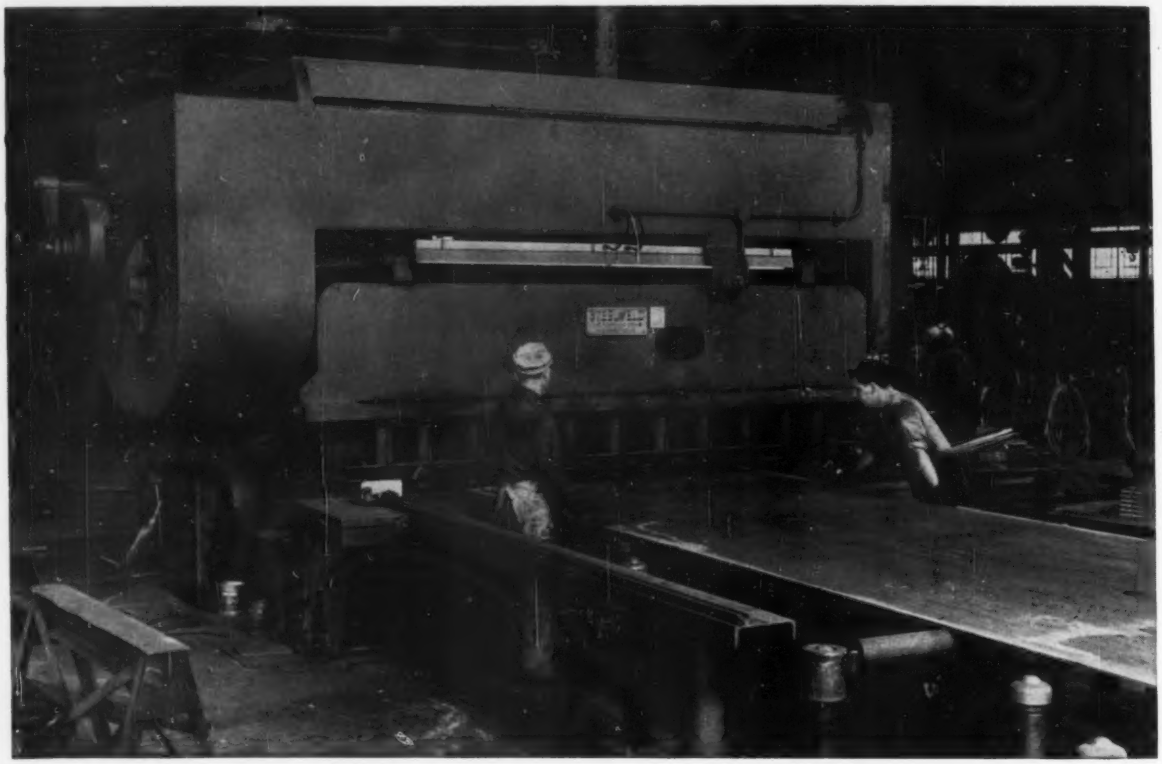

Pivoted-Blade Shears Outstanding for Heavy Plates

Steel plates up to 10' x 1" are quickly cut on this Steelweld. A complete line of machines is available for every thickness from light gauge to 1½" and every length from 6'-0" to 24'-0".

WHILE Steelweld Shears are used in hundreds of plants for cutting every gauge of metal, it is on heavy plate where the easy accurate cutting action of the machine is really eye catching. With nothing more than a quick "oomph" the knife goes through the metal quickly and cleanly, seemingly without effort. The resulting cut edges are straight and sharp.

Steelweld Shears are now cutting steel up to 1½ inches thick. A wonderful feature is the ease and speed with which the heavy plate machines can be adjusted to cut the lightest gauge metal. In a matter of seconds the clearance between the knives can be reduced to that known to provide the best result for the thickness of the plate being cut. This is done simply by turning a crank until a gauge indicator is on the correct thickness figure. This feature is known as MICRO-SET knife adjustment and is the talk of the industry.

Production is fast on Steelwelds because they are heavily built to enable high operating speeds. Also, they are equipped with electric foot control. This reduces operator fatigue and often eliminates many steps he must take to the machine.

If you want the most modern machine, with outstanding features that make for the finest in all around performance — tried and proven features, some of which are not obtainable in any other shear — we invite you to get the facts on Steelwelds.

GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.

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UNIVERSAL DRILL BUSHINGS
industry's standard of quality and service
All standard sizes and lengths available for immediate delivery.
100% concentricity and hardness tests insure accuracy.
Knurled heads provide good grip.
Write for free catalog describing Standard Drill Bushings, Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, Kwik-Switch Tool Holders, Mikro-Lok Boring Bars, Index Plungers and other Universal Products.
Superfinishing of Universal Drill Bushings is an important factor in keeping tool and bushing wear to a minimum . . . especially in close tolerance work. Blended radius helps prevent tool hang-up.
The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size. Request your calculator—free—on your company letterhead.
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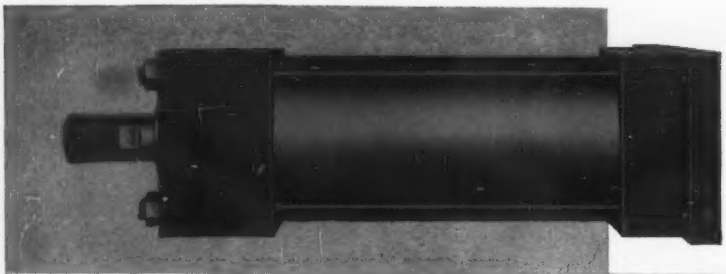
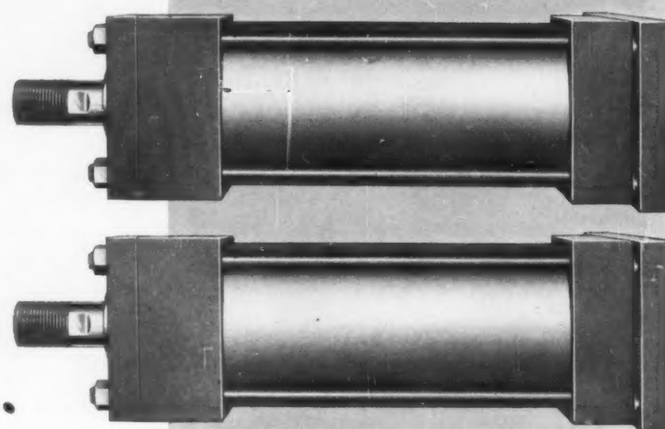


A LOGANSQUARE CYLINDER

2 competitors' cylinders



do they LOOK ALIKE? ...sure they do on the surface...

...BUT LOOK AT Logan's BIG EXTRA PLUS VALUES

Logansquare Cylinders are made to interchange with other leading manufacturers' cylinders . . .

1 Logan designs assure the service required for those extra-rugged applications.

2 Over FORTY YEARS of cylinder manufacturing know-how.

3 Built by CRAFTSMEN whose average service record with LOGAN is more than 20 years.

4 Manufactured in a plant which applies the most modern production methods.

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SEND FOR THE "LOGAN CALCULATOR"

MEMBER: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
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- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
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- ☐ ABC BOOKLET
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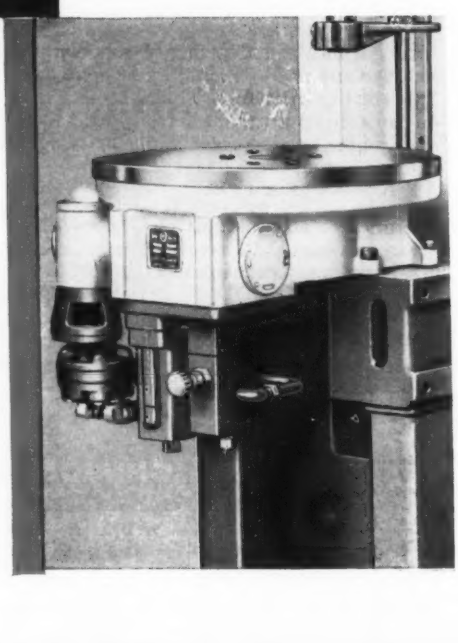
MEET THE NEWEST H-P-Ms . .

- 5, 10 and 15 Ton Models
- Completely JIC — All Models
- 2 Manual — 2 Automatic Systems
- All Controls Completely Interchangeable
- Small, Fast, Compact— Ideal For Automation
- Heavy Rugged Frames— Minimum Deflection
- Long Stroke — Plenty of Daylight
- Positive Ram Guides
- Complete Line Of Standard Accessories

THE FINEST INDEX TABLE-PRESS COMBINATION ON THE MARKET

The rugged H-P-M Index Table is designed specifically for use with the C-Frame hydraulic press. High speed and high load capacity effect a definite cost saving in the operator's time—no slowing the operation to suit the press. Indexing rate is fully adjustable and either clockwise or counter-clockwise rotation is available. Anti-friction bearings are used throughout—no bushing wear or tool misalignment can occur. The indexing mechanism is completely interlocked with the press ram action so that only one phase of operation can occur at any one time. The large 16" diameter work circle provides ample tool room as well as operator room. Ejector mechanisms or other auxiliary tools can be mounted directly to the housing. The hollow dial spindle permits the installation of air, water, gas, or electric lines through the housing to above the dial. Dial and spindle are sealed from the indexing mechanism so that liquids may be flooded over dial without damage to the indexing drive. Feature for feature—compare this H-P-M Index Table with any other on the market—it's the best!



the new Versatile H-P-M C PRESS!

CHOICE OF OPERATING CONTROLS

Manual Valve

This is the basic type hydraulic control valve. It is a spool-type 4-way valve designed specifically for press use. Mounted directly on the cylinder, it can be actuated by either dual levers, single lever, foot pedal or electrical control.

Manual -Servo Valve

This servo valve is a 4-way, spool type valve with an integral feed-back mechanism to effect servo operation and a differential circuit which equalizes ram closing and return speeds. Can be actuated by either single lever or foot pedal.

Automatic Valve

This compound valve is an automatic auto-cycling valve for use with manual controls, incorporating pressure reversal, stroke length reversal and inching control. Various manual or electrical controls are available for use with this valve.

Automatic Valve with Index Table

This valve is similar to the AM valve, above, with the added feature of provision for driving and interlocking the index table. Various manual or electrical controls are available for use with this valve.

The outstanding features of these new H-P-M C-Presses provide them with versatility not found in ordinary hydraulic presses. They are designed as basic automation units. Properly tooled, they may be used for special purpose, high speed applications—or, using interchangeable tools, they may be readily converted to general purpose jobs.

Over 80 years of specialized experience and engineering in the field of hydraulics have gone into their manufacture. Simplification of control, operation and maintenance has been the determining factor in their design. Precision and quality are inherent in their workmanship.

An H-P-M engineer's experience in the application of hydraulics can be of real help to you in the selection of the proper C-Press for your particular application. He is as near as your telephone. Call him today.

HPM

HYDRAULIC PRESS MFG. COMPANY

A DIVISION OF KOEHRING COMPANY
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I'm interested—please send complete catalog information on the new H-P-M C-Press Line. My primary interest is in—

☐ Manual Presses ☐ Automatic Presses ☐ Automatic Index Table Presses ☐ Tonnage ☐ Have salesman call as soon as possible.

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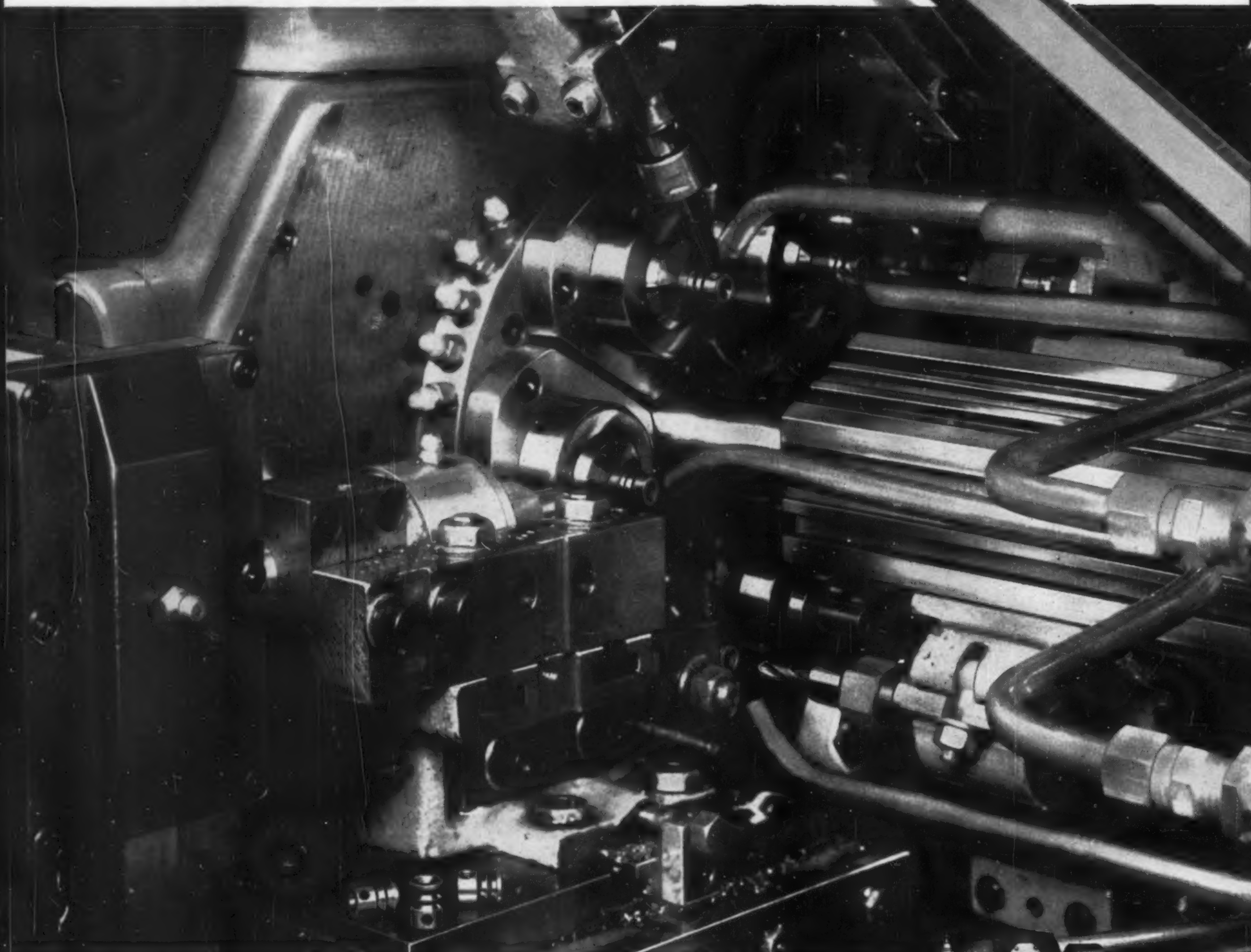
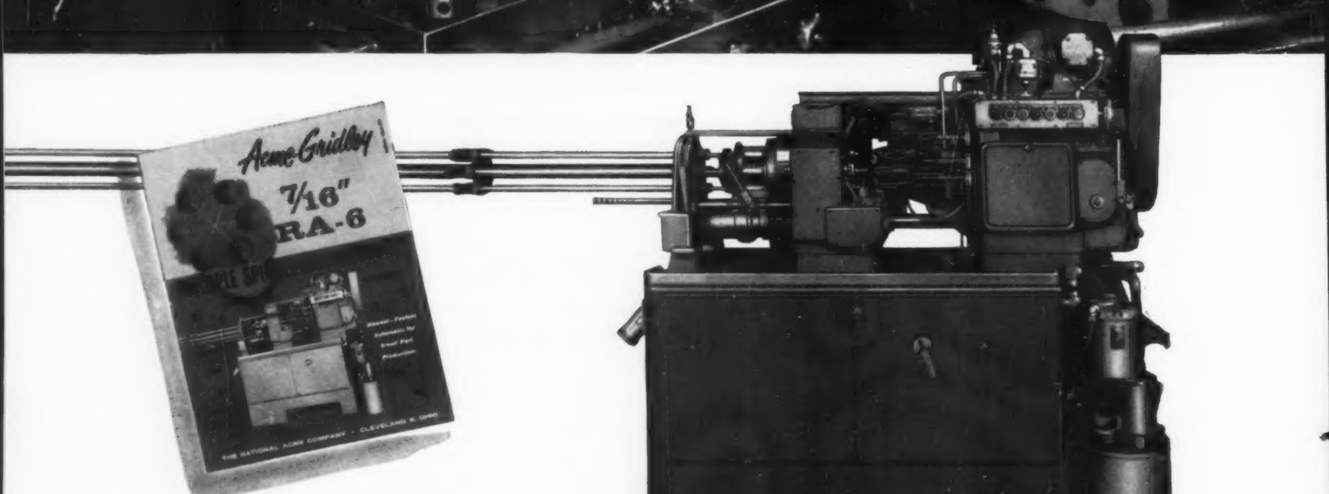
H830

Unusually large tooling zone permits ready access for installation and adjustment of tools and attachments.

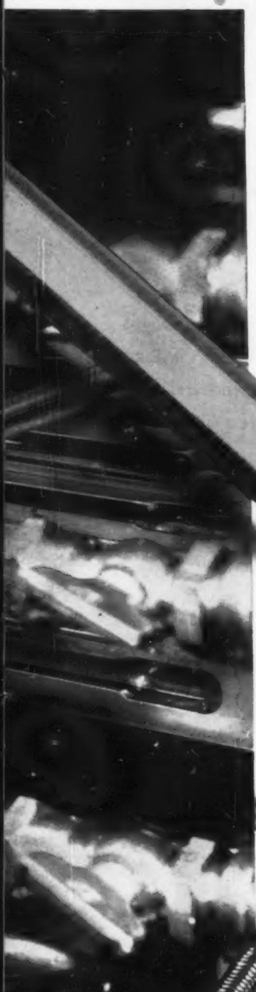




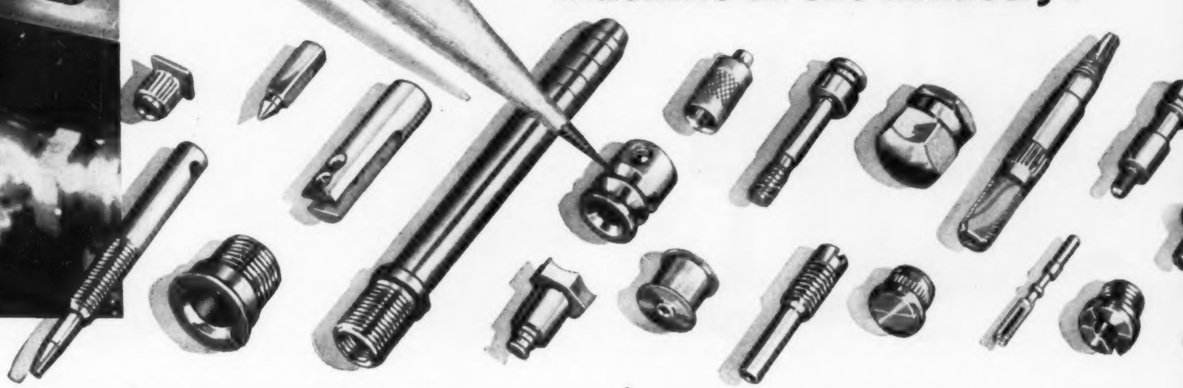
Call - Write - Wire - for the complete story on the industry's most modern approach to machine tool engineering . . . dedicated to low cost, mass production of small to miniature parts. Ask for Bulletin MRA-58.

THE 7/16" SIX.....

NEW ACME-GRIDLEY CONCEPT IN MULTIPLE SPINDLE AUTOMATICS



Longer runs without adjustment . . . greater sustained accuracy at lower cost . . . than any comparable machine in the industry!



. . . and we can prove it!

- **6 PRECISION SPINDLES**
  speeds up to 5200 r.p.m.
- **POSITIVE, DIRECT CAMMING**
  assures lasting accuracy
- **INDEPENDENTLY OPERATED TOOLSLIDES**
  greatly increase flexibility
- **RIGID, BOX-TYPE FRAME**
  provides the "beef", properly distributed that contributes to consistent accuracy at continuous high speeds

Remember...when you buy an Acme-Gridley 7/16" Multiple Spindle Bar Automatic, you're getting the newest, smallest, fastest machine from the world's *only* complete line of multiple and single spindle bar and chucking automatics. We've been making and improving them for 60 years . . . we think we know how!

National Acme

THE NATIONAL ACME COMPANY, 179 E. 131st ST., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N.J., Chicago 6, Ill., Detroit 27, Mich.

"Buffalo"

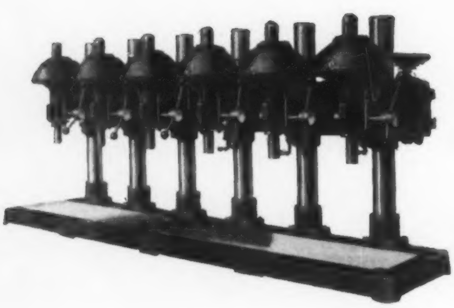
DRILLS "TEAM-UP" WITH TO INCREASE QUANTITY AND

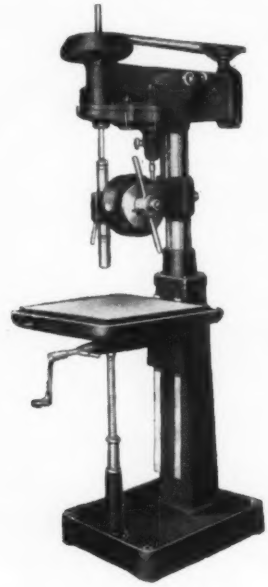
"Buffalo" offers a wide range of complete drilling machine lines in sizes, models and capacities to custom-fit all your jobs — from production and maintenance to tool room and other precision work. Choose from bench or floor types, single or multispindle, sensitive or power feed.

"Buffalo" Drilling Machines are designed for the utmost ease and simplicity of operation. They literally "team-up" with the operator as an incentive to higher quality production and faster runs. Sturdy, accurate, dependable, they are engineered with conveniently-located controls and are quickly adjustable for setup changeovers.

Whatever your drilling needs, contact your nearest "Buffalo" machine tool dealer. He will be glad to analyze your operations and recommend the drilling machine that's designed to fit your exact requirements. Or write us direct.

Engineered into every "Buffalo" product is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.





Heavy-Duty Drill for Multiple Operations

The "Buffalo" No. 18 Drill Line includes 19 models, enabling you to choose the drill that's best-suited to your needs. Models range from single spindle bench and floor drills to 6-spindle units. Powerful, rugged, easy to adjust and operate, the "Buffalo" No. 18 Drill is a flexible tool for general shop work up to 1 inch cast iron. Write for Bulletin 3123-E.

New! Packed with Advanced-Design features

The "Buffalo" No. 15 line of Drilling Machines is all new, from head to base. Retained are all the sturdy, speedy, easy-operating, trouble-free features of earlier models. Added are a host of design improvements which facilitate operation, flexibility and maintenance. Extremely sensitive, the No. 15 is also sufficiently rigid to operate at full capacity without wear or strain. Full information in Bulletin 4024 — write for it today.

More for Your Drill Dollars

The "Buffalo" No. 16 Drill is a "best buy" in its range. Check these features — then check the price: 5-speed V-belt drive — 4 rates of power feed — hardened tool steel clutch members — hand-scraped table ways. These assure you easier, faster drilling, more accurate work, longer useful tool life, lower overall production costs. For complete details on the "Buffalo" No. 16 Drill, write for Bulletin 3720-G.

YOUR OPERATORS
QUALITY OF OUTPUT!

POWER—
To Drill up to 1-¼" Holes in Mild Steel

"Buffalo" No. 22 Drills are ideally suited for high production drilling and tapping operations of a complex nature. With the No. 22, one man can operate up to four setups with no time out for adjustments. These sturdy, powerful machines handle as easily as smaller, sensitive drills — each spindle has both power and sensitive feed. See how you can cut costs and speed production with "Buffalo" No. 22 Drilling machines. Write for Bulletin 2989-G today.

Speeds Instantly Changed with No Lost Time

The "Buffalo" "RPMster" features "line-of-sight" controls that enable the operator to change spindle speeds instantly in the range between 100 and 3000 RPM. The gearless drive and precision construction assure a minimum of vibration at all speeds. Hand scraped ways on head and table. The versatile "RPMster" will improve production in all your drilling, reaming and tapping operations. For full information, write for Bulletin 3967-A.

BUFFALO FORGE COMPANY

440 Broadway • Buffalo, N. Y.

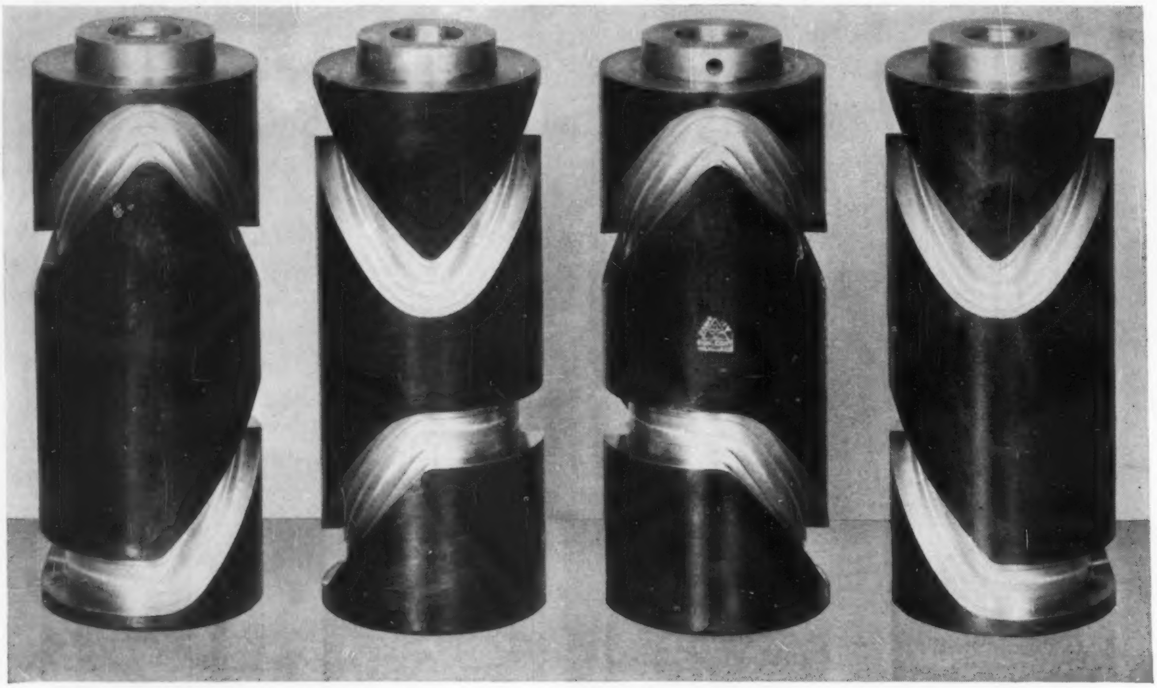
Canadian Blower & Forge Co., Ltd. • Kitchener, Ont.

DRILLING PUNCHING SHEARING BENDING

ESTABLISHED 1877
"Buffalo"
MEMBER N.M.T.B.A.

"We produce better cams at lower cost with GRAPH-MO® steel"

. . . says L. G. Schlecht & Son, Inc.



TO make cams of all types—some small, some large—and produce them better at lower cost—L. G. Schlecht & Son, Inc., chooses Graph-Mo® steel. Developed by the Timken Company, it's a special oil hardening tool steel that machines faster and easier than ordinary steels. Result: machining time and production costs are cut.

Graph-Mo wears longer, because of the combination of free graphite and diamond-hard carbides in its structure. Users report it outwears other tool steels 3 to 1! What's more, Graph-Mo responds uniformly to heat treatment, minimizing distortion—saving time and money on the trickiest, toughest jobs. And it has minimum tendency to pick up, scuff or gall.

Graph-Mo is one of four graphitic tool steels developed by the Timken Company. They have many uses in producing machine parts, dies, punches and gages . . . giving a better product at lower cost. For more information, send for the Timken Company's Graphitic Steel Book, or call or write our engineers. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".

Timken graphitic steels are carried in stock by 9 distributors with 42 warehouses in 31 cities in the United States and Canada.

TIMKEN *Fine Alloy* STEEL

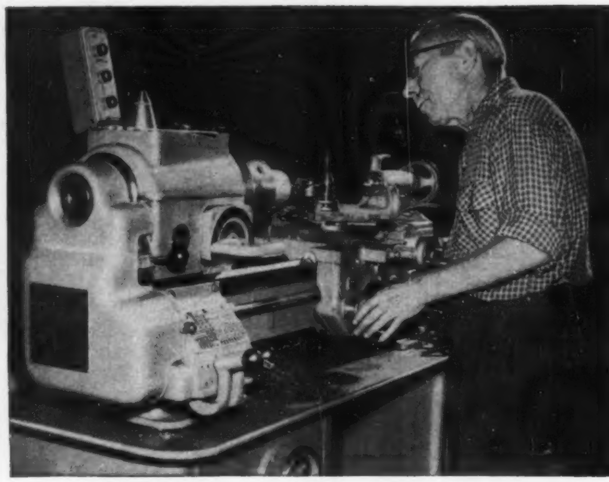
TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

For more info on any products advertised this issue use card, page 201


ALLEN-BRADLEY
BULLETIN 802T
OILTIGHT
LIMIT SWITCHES
Radial mounting of six Allen-Bradley "manifold" type, push roller, oiltight limit switches.
Push roller, oiltight limit switch, showing rubber grommeted wiring hole on back of "manifold" type, used on above automatic production machine made by Cross Company, Detroit.
SIDE PUSH ROD
FORK LEVER TYPE
ADJUSTABLE ROD
TOP PUSH ROD WITH PLASTIC WINDOW
OIL SEALED HEAD
AND BODY
assure reliable operation
Completely sealed . . . oil, dirt, and metal chips cannot foul up contacts or operating mechanism. Operating heads are interchangeable—can be mounted in any one of four positions. New "wobble stick" heads operate in any direction. All of these limit switches have maintenance free, double break, silver alloy contacts. Specify Allen-Bradley—the quality line of limit switches.
WOBBLE STICK TYPE
ROLLER LEVER FOR CAVITY MOUNTING
ADJUSTABLE ROLLER LEVER
A-B QUALITY
ALLEN-BRADLEY
MOTOR CONTROL
QUALITY
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

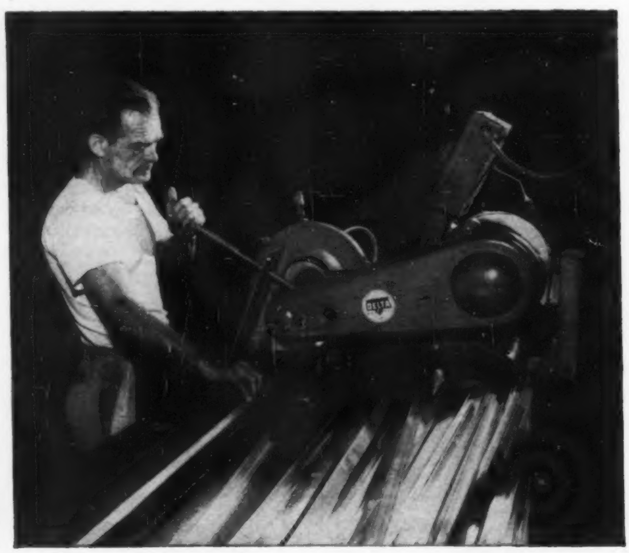
DELTA INDUSTRIAL



DELTA 20" DRILL PRESSES are built to give you machine tool production capacity with power tool flexibility. Massive construction and rugged power make the Delta 20" a heavy-duty tool. Available with hand or power feed, choice of No. 2 or No. 3 Morse taper spindle. 28 models include floor, bench, multiple spindle and overhead types. Production tables, heads and columns available as components.

DELTA 11" METAL LATHES offer exclusive Delta Quality features such as massive head stock construction, perfected variable speed drive, unique 4-position drive selector and many more. Both 4 ft. and 5 ft. bed models available with flame hardened bed. And you get the double versatility of a ram-type turret lathe, when you add production accessories for precision multiple machining jobs.

A proved way to cut your costs

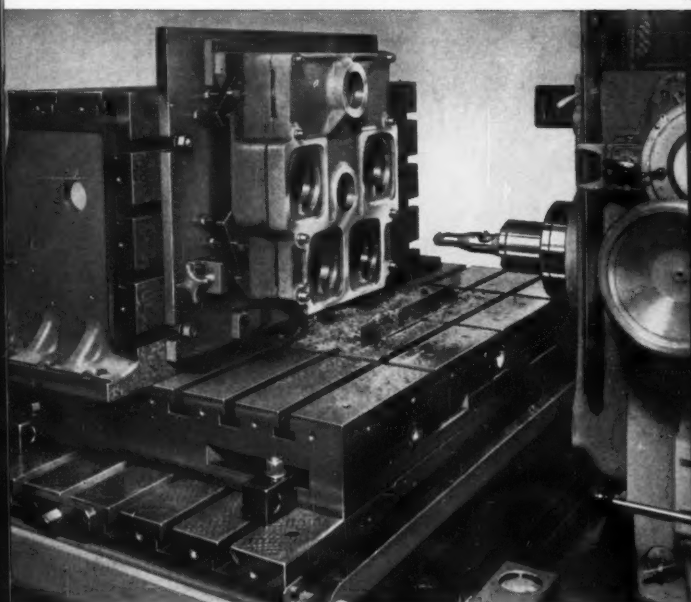


DELTA 17" DRILL PRESSES in over 70 models enable you to make your own single or multiple spindle set-up for drilling, counterboring, reaming and tapping jobs. Finest in their class, they are engineered for precision work and built for long life with low maintenance costs. Standard or power feed, high or slo speed and key chuck or tapered spindle available in floor, bench and multiple spindle models.

DELTA CUT-OFF MACHINES for fast, smooth, accurate cuts are speeding production and improving quality in tool rooms, maintenance departments and on production lines. Work head pivots for easy mitering. All belts, pulleys, cutting wheels or blades are fully enclosed for maximum safety. Whether you do wet abrasive or dry abrasive cutting, or cut non-ferrous metals or wood—you choose the model that's right for your job.

SOME OF OUR JIGMIL USERS

Adams Div., LeTourneau-Westinghouse Co.
Akron Standard Mold Co.
Allen Tool Corp.
American Machine & Foundry Co.
Andale Company
Baker-Perkins, Inc.
Bell Aircraft Corp.
Bendix Products Div. of Bendix Aviation Corp.
Bryant Chucking Grinder Co.
Buick Motor Div., General Motors Corp.
J. I. Case Co.
Cleveland Trencher Co.
Danroy Boring Co.
Daystrom Inc.
Denison Engineering Div. American Brake Shoe Co.
Eclipse-Pioneer Div., Bendix Aviation Corp.
Emsco Manufacturing Co.
Evans Reamer & Machine Co.
Fairchild Engine & Airplane Corp.
Fenn Manufacturing Co., The
R. H. Freitag Mfg. Co.
Goodyear Tire & Rubber Co., Inc.
Halliburton Oil Well Cementing Co.
Heintz Div. Kelsey-Hayes Co.
Hughes Tool Co.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

ANOTHER EXAMPLE OF JIGMIL PRECISION
applied to guided missile production

Speco Division, Kelsey-Hayes Co., uses the JIGMIL Technique to bore and mill to precise limits of accuracy a wide range of guided missile components such as the one above. Because of their speed, accuracy and versatility, Speco also uses its 5 JIGMILS in the production of such critical items as aircraft and helicopter transmissions, hydraulic control systems, radar antennas, rocket and jet engine precision gears and assemblies.

Improved Paper Machinery Corp.
McDonnell Aircraft Corp.
Mechanical Specialties Co.
Michigan Drill Head Co.
Oil Well Supply Div. U.S. Steel Corporation
Paramount Boring & Machine Co.
Princeton University, Forrestal Research Center
Rheem Mfg. Co.
Sandia Corp., Sandia Base, U.S. Atomic Energy Comm.
Stanley Aviation Corp.
Teppert Tool & Eng., Inc.
Van Norman Machine Company
Wabash Mfg. Co., Inc.
Wiedemann Machine Co.
Worthington Corporation

WILL YOU BE THE NEXT TO VISIT FAIR STREET

Our newest catalog will help you decide. May we send it?

DeVlieg

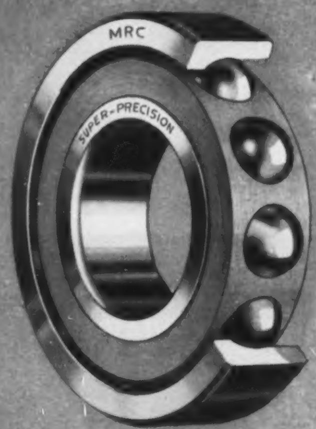
SPIRAMATIC JIGMILS®

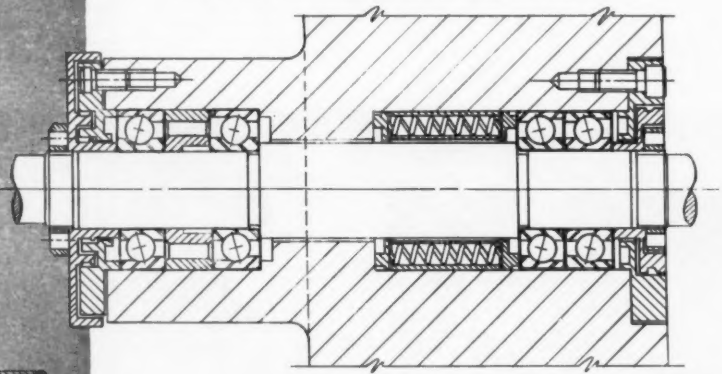
ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

Long life accuracy

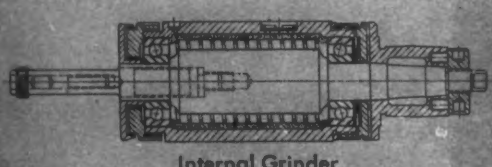
IN MACHINE TOOL SPINDLES

with M-R-C SUPER-PRECISION BALL BEARINGS

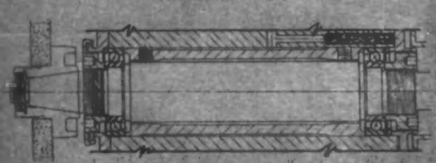




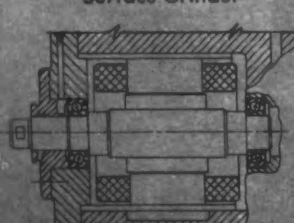
Grinder Spindle



Internal Grinder



Surface Grinder



Hi-Frequency Wheelhead

M-R-C Ball Bearings are used today in many leading machine tool spindles operating successfully at 100,000 RPM and over.

The illustration above is an example of a successful application of M-R-C SUPER-PRECISION bearings. This grinder spindle requires the highest degree of accuracy and long life obtainable only with M-R-C SUPER-PRECISION.

Still higher standards have been made possible by the facilities of our new SUPER-PRECISION plant devoted exclusively to this type bearing.

There is a M-R-C Ball Bearing for every machine tool application requiring accuracy and long life.

Consult OUR Engineering Department on YOUR bearing problems

MRC
BALL AND ROLLER *bearings*

MARLIN-ROCKWELL CORPORATION

Executive Offices: **Jamestown, N.Y.**

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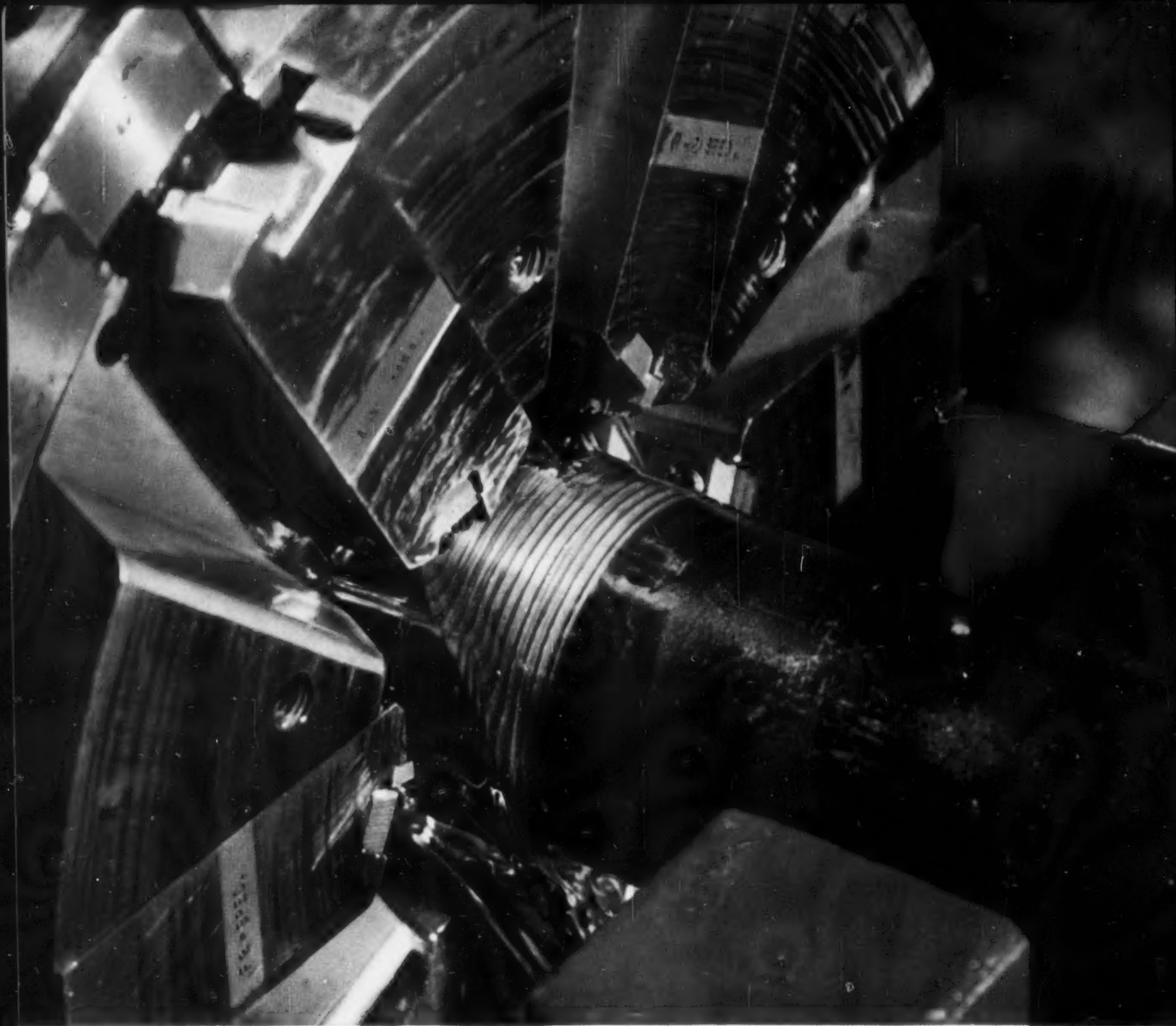
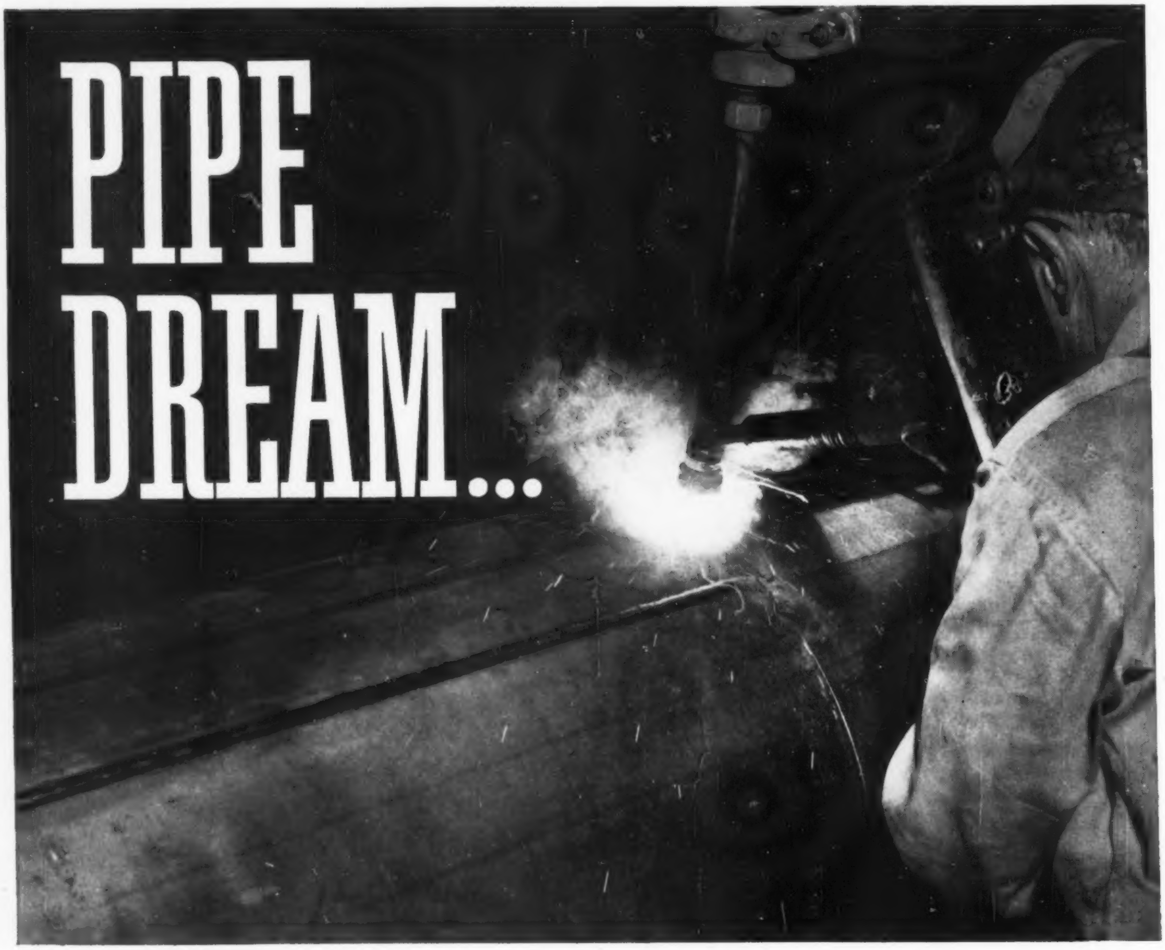


This is just one of the many applications of Sunicut 85, which is one of a whole series of Sunicuts . . . all transparent.



...UNIONARC Welding saves $7000 on one production run

UNIONARC Welding—LINDE's new electric welding method for steel—increased production by 300% and saved a western pipe mill $7000 on a single run of steel pipe. Replacing covered electrode methods, UNIONARC Welding is expected to save this company $150,000 a year.

UNIONARC Welding uses a continuously-fed wire electrode, magnetically coated with flux and shielded with carbon dioxide gas. It has three times the speed and weld penetration of covered electrode welding. And UNIONARC Welding gives you "finished", X-ray quality welds and low hydrogen deposits—in all welding positions.

See for yourself—ask your nearest LINDE representative to *prove* that UNIONARC Welding slashes time and labor costs over conventional methods. Call your local LINDE office today! Or write Dept. MY9 LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde
TRADE-MARK

UNION CARBIDE

"Linde", "Unionarc", and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

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how the **LINK-BELT COMPANY**

reduces its cost savings opportunities to careful analysis

Date September 27, 1950

LINK-BELT COMPANY

Estimate No. 30

EQUIPMENT REPLACEMENT ANALYSIS

Line No.	Present		Proposed
1. Description -	1 - [redacted] Machine	Description -	1 - [redacted] Machine
2. Salvage Value	$ 3,785.00	Cost of New Equipment	$17,800.00
3. Age	12	Service Life	16½ years
4. Equipment No.	963	Estimated Salvage Value	2,500.00
5. Department	DM	Salvage Ratio	14%
Adverse Minimums			
6. Operating Inferiority	$ 4,845.00	Cost of New Equipment	$17,800.00
7. Loss Salvage Value-Next Year	200.00	Chart Per Cent	7%
8. Interest - Salvage Value	378.00	Interest Per Cent	10%
9. Proration - Capital Addition		Total Per Cent	17%
10. Interest - Capital Addition			
11. Adverse Minimum - A	$ 5,423.00	Adverse Minimum - B	2,848.00
12. Gain from Replacement (Next Year) (A Minus B)	*$ 2,575.00		

OPERATING ADVANTAGE (NEXT YEAR)

	Present C	Proposed D
13. Direct Labor		$ 1,331.20
14. Overhead Expense		2,529.28
15. Auxiliary Expense	$ 500.00	998.40
16. Administrative Expense		485.89
17. Other		
18. TOTAL	500.00	5,344.77
19. Net Operating Advantage (D Minus C) to line 6	$ 4,845.00	

Percentage of Reduction in Direct Labor 40%

Percentage of Increase in Production 60%

Remarks

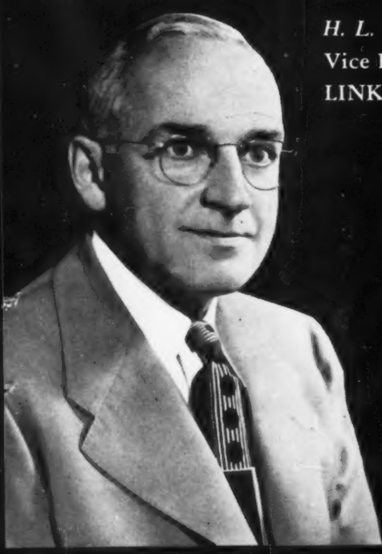
Recommendation

Signed | Approved H. C. Robson

Date | Date August 10, 1950

920-8-50

"THERE are two principal reasons for replacing industrial equipment: obsolescence and general deterioration. We much prefer to replace equipment because of obsolescence, since this means that we have found a better, quicker, or cheaper method of manufacture. With techniques changing as rapidly as in this day of great technological advancement, it is usually unprofitable to keep a machine until general deterioration requires its replacement with a similar unit."



H. L. Hoefman
Vice President for Manufacture
LINK-BELT COMPANY

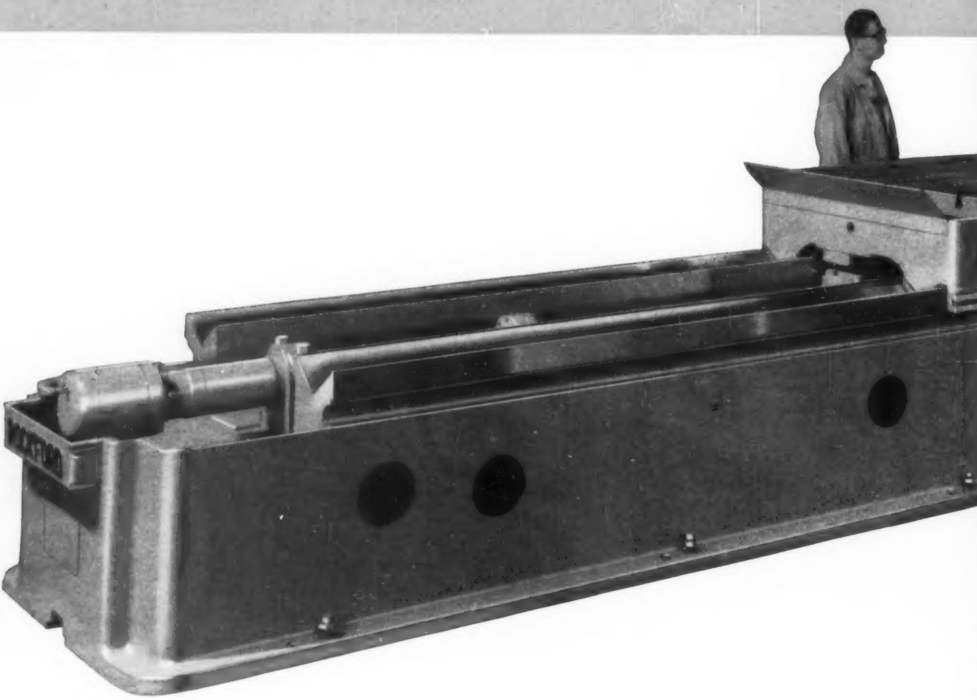
* **GAIN** from replacement by the Link-Belt formula is $2575.00 after required interest or return on the new investment . . . after full allowance (by the formula) for *future* obsolescence of the new equipment.

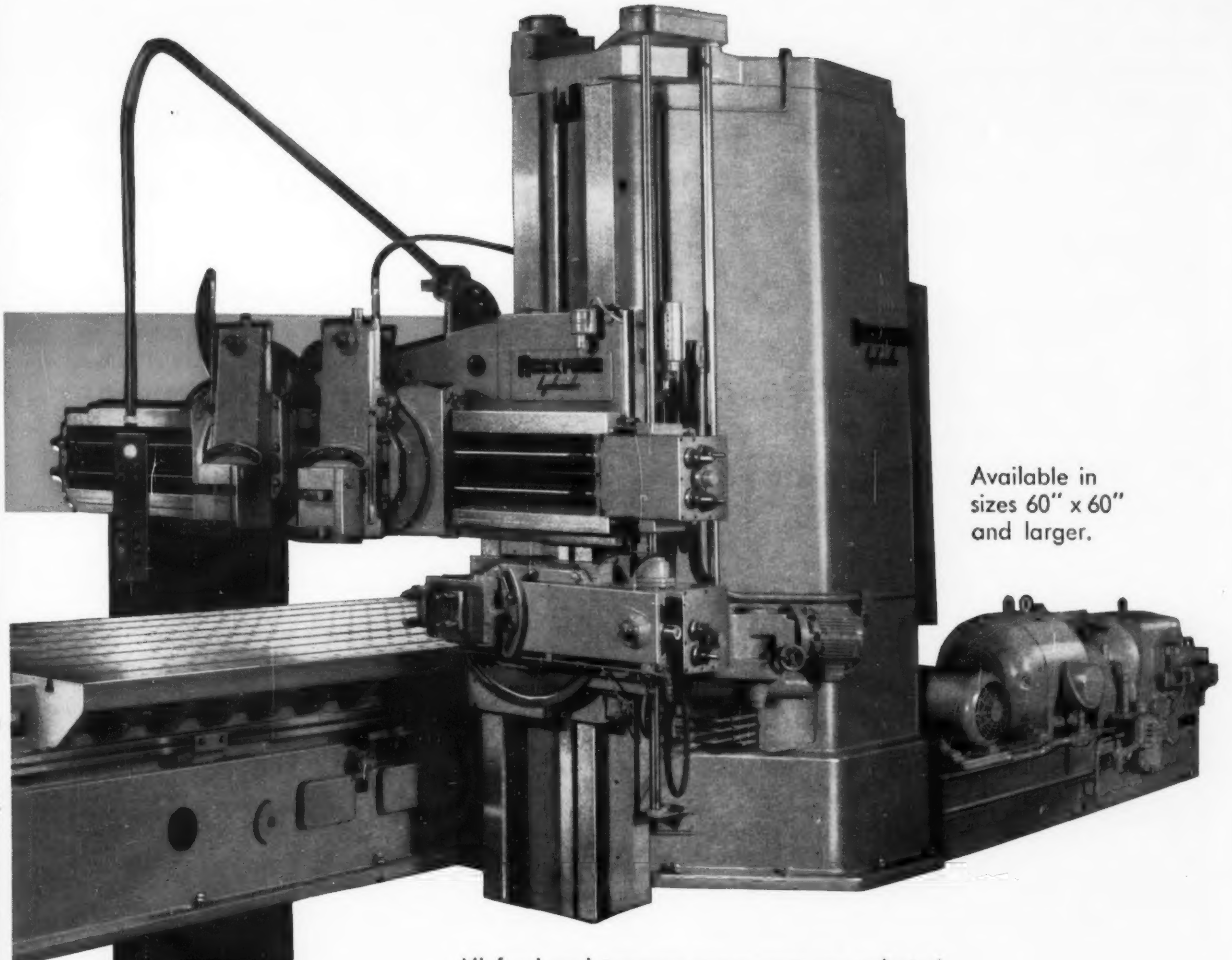
Keep gathering metal-working production ideas . . . be well informed when you replace machinery . . . .

Rockford Insert Group

2-speed traverse motors eliminate manual positioning in set-up on

new Rockford Hydraulic Planer





Available in sizes 60" x 60" and larger.

complete pendant control speeds operation and set-up

All feed and traverse movements are selected and operated from the push button station of this new Rockford hydraulic planer. Two-speed traverse motors — high speed for approximate positioning, and slow speed for extremely close power positioning of rail and side heads — eliminate the need for manual positioning in setting-up for a job.

Extra-rugged construction affords use of most modern cutting tools and cutting techniques. The machine is equipped with the new high speed h3 triple circuit.

Get full details on the wide production flexibility of this new hydraulic planer from any Rockford Machine Tool Co. representative, or write directly to us.

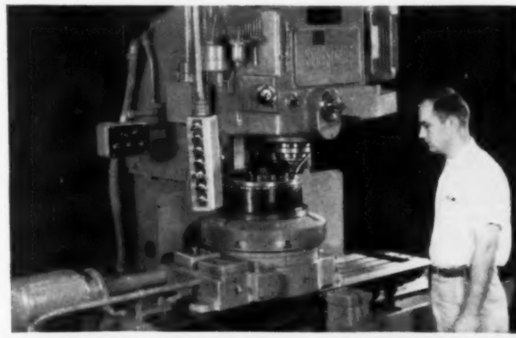
h HYDRAULIC

ROCKFORD MACHINE TOOL CO.
2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

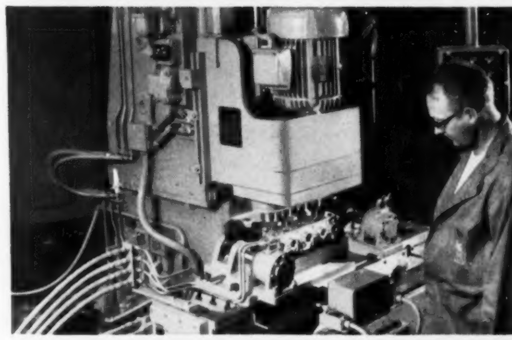
IN MILLING Sundstrand's unit construction gives you the opportunity of choosing from far more than the normal range of standard machines. The ideal combination of head, column, table and base can be provided in a standard machine; semi-standards are built up similarly at minimum cost. Even special machines can often be designed using standard components to cut costs.

STANDARD RIGIDMILS



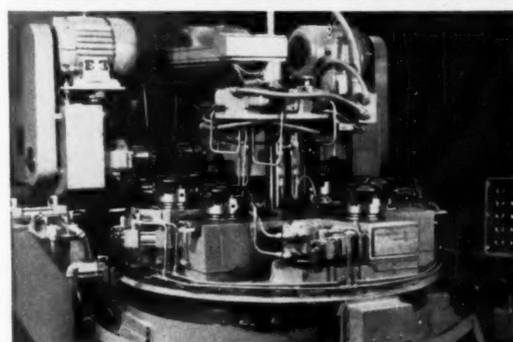
An 82% reduction in machining time resulted in changing over from the former method of milling 28 scallops in periphery of steel housing to a standard Sundstrand vertical head Rigidmil. Machine is also equipped with an automatic index base. Cycle is completely automatic except for loading and unloading of work holding fixture.

SEMI-STANDARD RIGIDMILS



Aluminum alloy cylinder head has four combustion chambers form-milled simultaneously on a semi-standard Rigidmil equipped with special 4-spindle vertical head. Vertical feed to head and longitudinal feed to table are timed and interlocked in automatic cycle. Operator only loads and unloads parts in the work holding fixture and presses cycle start button. Production is 85 pieces per hour.

SPECIAL MACHINES



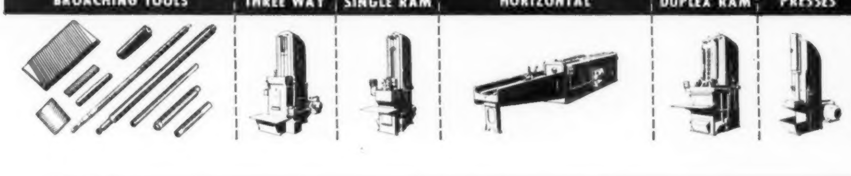
Machine is equipped with three milling heads carried on a horizontally fed cross slide to mill six equally spaced slots in ring part at approximately 155 pieces per hour. Six indexing type work holding fixtures, each arranged to hold one part are mounted on the 48-inch diameter indexing table. Entire cycle is automatic except for loading and unloading work holding fixture.

Get details about how Sundstrand "Engineered Production" has provided answers on numerous production milling and turning jobs by writing for Bulletins 695 today. You can get the same expert help on your broaching and grinding problems, too.

SUNDSTRAND MACHINE TOOL CO.

2530 ELEVENTH ST., ROCKFORD, ILLINOIS

BROACHING TOOLS	THREE WAY	SINGLE RAM	HORIZONTAL	DUPLEX RAM	PRESSES



SUNDSTRAND "Engineered Production Service"

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

What kind of man buys new machine tools today?

What Mattison has observed about the "beat-them-to-the-punch" production executives who are investing *now* in new machine tools and methods!

An editorial by Alan C. Mattison, President

■ Never before in our history have we been so busy preparing production estimates and quoting high-powered precision surface grinders for so many interesting, new applications.

There is terrific interest in cost cutting. Men who are buying new machine tools are acutely aware of the high, cumulative cost of deferring profit-making capital expenditures. They're looking for quick, positive ways to lower breakeven points. Many are looking ahead five years and "getting ready." All of them are experiencing (and taking advantage of) their first real "breathing spell" from breakneck production, looking with a critical and evaluating eye at "standpat" tooling and methods. Presently, over 50% of Mattison's current business is in *new methods*—applying surface grinding for stock removal to save time, increase quality, and reduce material cost.

But some managements are "sitting on the lid," putting off purchases of machine tools needed by the shop. Some of this may be the result of complacency or uncertainty. But in view of all realistic forecasts and studies, shortsighted curtailment of needed capital investment *in these times* is due for cold reappraisal.

Today's reduced volume just a "lull" in the long-range picture

Even with today's slowdown and population growth, we are still looking ahead to labor shortages. Each worker in the boom 1960's is going to have to produce more than the average worker today. The only way he is going to do it is with more horsepower—more productive machine tools, plus automatic workhandling and assembly. What are businessmen actually planning now in the way of new tooling for the years 1958 to 1961?

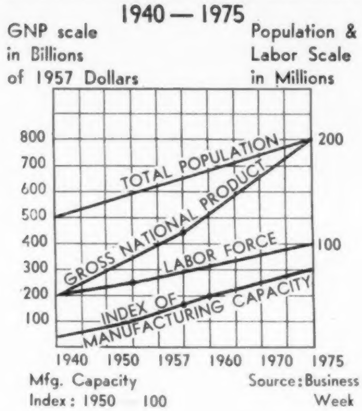
Plants accounting for almost 40% of all manufacturing employment were surveyed by the McGraw-Hill Department of Economics, pointing up the following:

1. Manufacturers expect their sales to increase 20% from 1958 to 1961.

2. These companies showed an average operating rate of 78% at the end of 1957, and with the expected increase

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

National Growth Patterns
1940 — 1975



in sales and planned expansion, the average operating rate will rise to about 85% by 1961.

3. Although a substantial number of companies plan to add new capacity each year during the next four years, most plants will put major emphasis on modernization and cost cutting. In 1958, 56% of capital expenditures will go for replacement of obsolete equipment and this is expected to increase to 62% by 1961.

Thus, we are looking ahead to periods of more labor shortages, near-capacity production, rising costs, machine tools in short supply, and again, so much emphasis on production that methods, tooling, and cost-saving will take another five-year setback.

There never will be a better time to buy machine tools

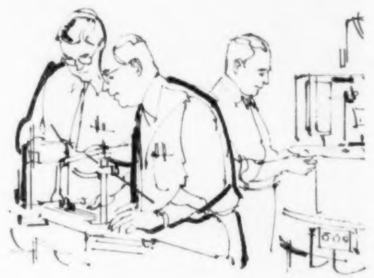
Undaunted machinery buyers are now getting bigger values than ever before. If you are planning new products, or expect to increase production and productivity at a rate that is on a "par" with the rate of economic expansion predicted on the basis of known population growth, now is the *one best time* to buy general-purpose machines that permit flexibility of production, save material costs, increase accuracy for easier or automatic assembly, and provide high productivity per manhour. Here are some of the reasons leading companies are buying surface grinders for their immediate and long-range needs:

1. Protect profits — Higher efficiency due to reduced downtime for wheel maintenance, lower material cost due to reduced stock allowances, and higher accuracy of surface grinders add up to higher profits at today's reduced volume.

2. "Outside thinking" — You can buy machine tools now and get the benefit of outside thinking and re-evaluation because machine tool builders have the available time and manpower to help you study your piecepart design, provide detailed production estimates, perform sample machining, and develop the special machine "package" your operations might require to produce an overall reduction in floor space, materials handling, and operational cost.

As one leading manufacturer has said, anyone who hasn't re-audited his equipment and methods during the last five years, or whose costs have remained stabilized, is probably harboring obsolescence.

3. High earning power — With interest rates down and costs going up, alert manufacturers are looking for opportunities to invest money in modern machine tools which provide a high profit yield. Sure, a machine tool must be easy to operate, accurate, a fast producer —but what is its earning capacity as compared with an equivalent investment in selling or new products? Can you put money presently invested elsewhere into modernization and get up to 30% return, instead of 6 or 12%? What is it costing you every day not to invest in a new surface grinder that will do a better job, faster, with only a handful of swarf—operations that normally demand high tool costs, slow production, and bushels of costly chips? Why not invest in money-making modernization for your *own* future and the 1960 boom?



4. High cost of waiting — When industry starts booming, and costs spiral upward, prices of machine tools are almost sure to rise.

5. Get what you want — With all the types of machinery available on relatively short delivery, you can select and get the best quality product closely matched to your immediate and long-range needs. New high-powered surface grinders will eliminate rejects and downtime, *now* as well as later, and give you a guaranteed hedge against competitive disadvantage.

Let Mattison help you get ready for higher profits today and efficient, high production for your expanding operations tomorrow. We offer you production capacity, engineering talent, demonstration facilities, and on-the-job evaluation —you'll get more value for your machine tool dollar than you may ever get again.

EXAMPLE OF COST SAVINGS

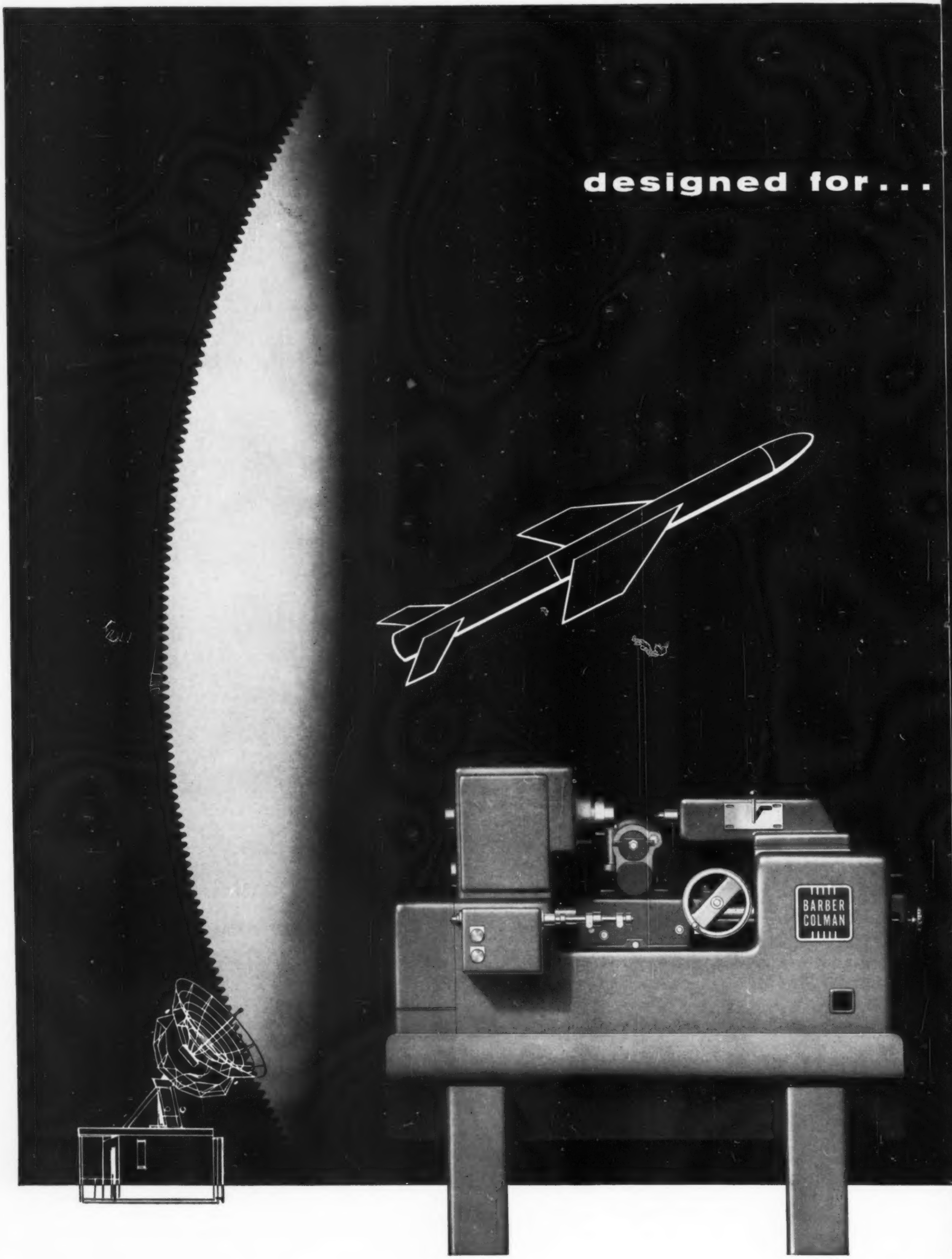
A machinery manufacturer formerly milled forged steel chain links at the rate of 33 per hour, with a tool replacement cost of 39¢ per piece. This cost consisted of:

- **a. cutter changing cost of $ .15 per piece**
- **b. cutter depreciation cost of $ .0835 per piece**
- **c. cutter sharpening cost of $ .16 per piece**

Machining cost was $ .13 per piece. After switching to a Mattison surface grinder, production jumped to 58.6 pieces per hour. Tool replacement cost was reduced to $ .04 per piece. Machining costs dropped to $ .05, making a total cost reduction of $ .43 per piece. At a cost saving of more than $2,000 a day, how could this company earn a higher return from its money or borrowed capital?

MATTISON
MACHINE WORKS
ROCKFORD, ILL. U.S.A.

MATTISON MACHINE WORKS
Rockford, Illinois **Phone: 2-5521**


designed for...
BARBER
COLMAN

...precision instrument gears

new Barber-Colman hobber guaranteed to index accurately within 20 seconds of arc

Barber-Colman engineers have developed a new hobbing machine which guarantees indexing accuracy suited to gears used for aircraft, missile and radar guidance systems. This machine is known as the No. $2\frac{1}{2}$ - 4 hobbing machine and hobs precision spur gears up to $2\frac{1}{2}''$ diameter x $2\frac{1}{4}''$ face width, 30 D.P. in steel and 20 D.P. in brass. It provides accuracy, capacity and rigidity for precision fine-pitch work within a nominal price range.

One of the most important features of the new No. $2\frac{1}{2}$ - 4 hobbing machine is the accuracy of relative rotation between the work spindle and the hob spindle which is guaranteed within 20 seconds of arc. This means that the spacing error on the gear caused by the indexing error of the machine would not exceed .00014" on a $2\frac{1}{2}''$ diameter gear.

The machine has a capacity for using 3" diameter hobs providing for a greater number of flutes to produce smooth gear tooth profiles. Using proper care in rigid tooling, accurate blanks, mounting of hob and work, and Class AA hobs with accurate sharpening, precision gears to Class 3 tolerances are hobbed with this machine.

Several design features are a departure from standard hobbing machine construction. There is no hob slide — only a hob carriage for conventional feed. In place of a hob slide, the hob arbor is mounted on a swivel which adjusts to compensate for hob thread angle. The work slide is stationary, and the hob swivel raises and lowers to meet diameter requirements. The machine has no overarm support, permitting greater work visibility and operator access. Both work and hob spindles are mounted in precision anti-friction bearings to provide accurate rotation at high speeds. The hob carriage also has anti-friction way supports, and the metal-to-metal contact afforded provides more rigidity than obtained with gib-type mounting. An infinite number of hob speeds are provided without change gears in the range of 200 to 1200 r.p.m.

Rigidly constructed, with a steel weldment base and heavy grey iron machine bed, the machine is designed with a minimum number of parts at points where deflection and inaccuracies may occur. Net machine weight without tooling is approximately 1500 lbs. Standard equipment includes motor and controls and one set of change gears.

For complete specifications and data contact your nearest Barber-Colman representative, or write directly to the factory for a copy of new bulletin F-8642.

BARBER-COLMAN COMPANY

729 ROCK STREET • ROCKFORD, ILLINOIS

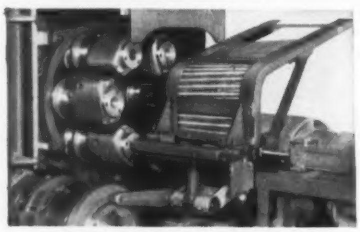
Hobs • Cutters • Reamers • Hobbing Machines • Hob Sharpening Machines

BARBER COLMAN

Second Operation

CONVEYOR LOADING


MAGAZINE LOADING


REAR LOADING MAGAZINE


HAND LOADING

A Method of Machining That Pays Off

Greenlee standard Automatic Bar Machines, adapted for second operation work, profitably machine a wide variety of parts. Long shafts or short pieces are automatically loaded into the work spindle by any of the various loading arrangements shown. Parts are loaded in one position during the machining cycle, and machined in the remaining five cross slide and end working positions. For more information, see your Greenlee Distributor.

WRITE FOR CATALOG No. A-405

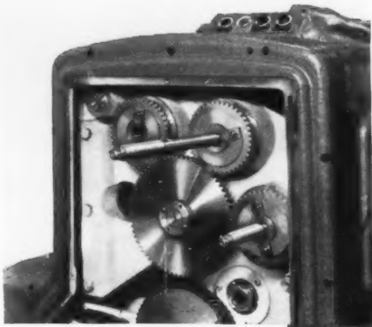
GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines

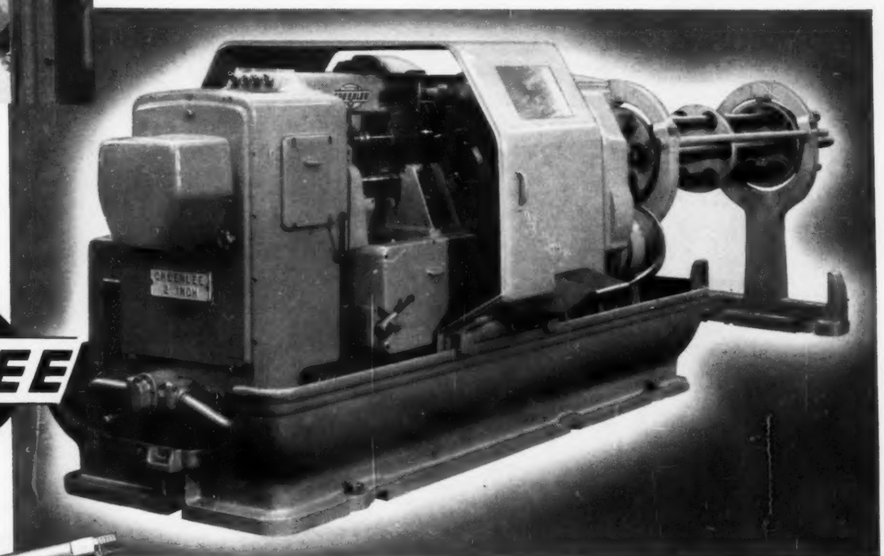
GREENLEE
BROS. & CO.

1869 MASON AVE.
ROCKFORD, ILL.

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**



GREENLEE LEAD-SCREW FEED ASSURES *Precision* THREADING and TAPPING



PRODUCTION MACHINERY
GREENLEE

PRODUCES UNIFORM HIGH QUALITY... Reduces Scrap... Lowers Costs!

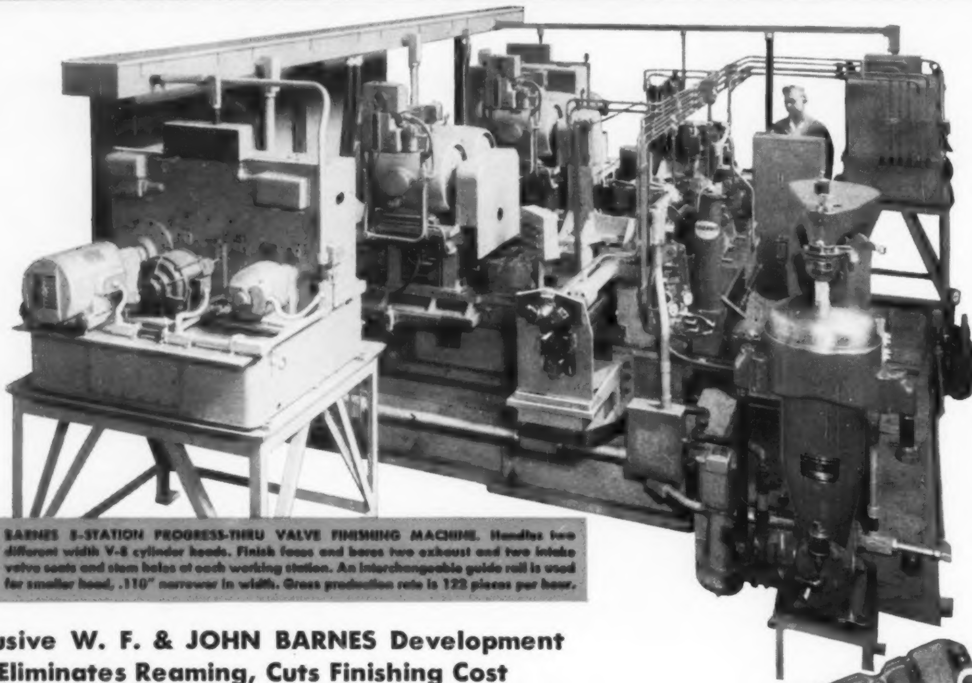
The Greenlee precision lead-screw threading arrangement makes it easy to machine parts otherwise impractical on an automatic bar machine. Precision Acme, tapered and multi-lead threads are machined in the high speed and feed ranges required. Smooth, clean thread form, fine fit and high tolerance concentricity make lead-screw threading profitable. Built-In Duplex clutches on 6-spindle machines reduce set-up time on simultaneous tapping and multi-tooled jobs. The profitable lead-screw arrangement can be applied to Greenlee machines in the field as well as on new Greenlee Automatics. It will pay you to investigate.

Want more information? Write today for Catalog A-405.

GREENLEE BROS. & CO.
1869 Mason Ave.
Rockford, Illinois

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass



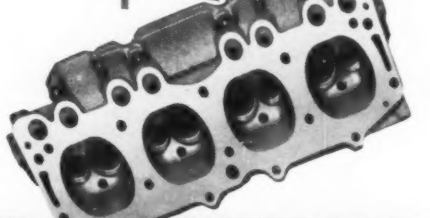
BARNES 8-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide rail is used for smaller head, .110" narrower in width. Gross production rate is 122 pieces per hour.

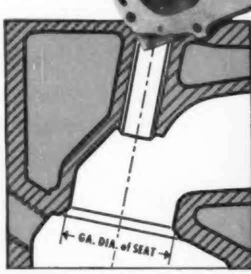
Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

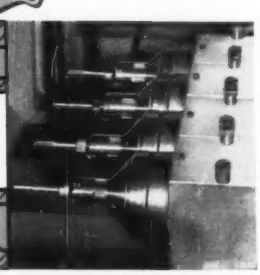
The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.





CONCENTRICITY .0005" T.I.R.

Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0005" T.I.R.



DUAL-TYPE PRECISION SPINDLES

Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines
Since 1872

W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. *Write for New Catalog* illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

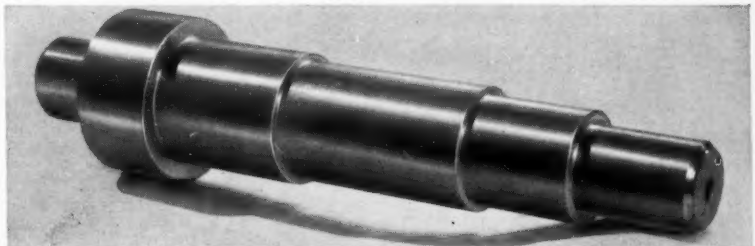
Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

Production time reduced 82% on new lathe

PROFIT TURNING POINT

New Barber-Colman 36-speed lathe does 13 operations on drive gear and shaft in 22.7 minutes



STANDARD TIME	OLD LATHE	NEW 36-SPEED LATHE
SETUP TIME (hours)	1.09	1.75
SPEEDS (rpm) FEED (inches per rev.)	350 .015	644 to 912 .013
PRODUCTION (per hour)	0.47	2.64

Turning time on the drive gear and shaft shown in the illustration was reduced from 126 minutes to 22.7 minutes when transferred from an old lathe to a new Barber-Colman 36-speed lathe.

The shaft is 15″ in length with a maximum diameter of 3.744″. Spindle speeds range from 644 rpm to 912 rpm, and the feed is .013″ per revolution. On the old lathe, speed was 350 rpm and the feed was .015″ per revolution. This is a good example of how machine horsepower, accuracy, rigidity, and operational features can reduce costs drastically.

Easy-to-set up Barber-Colman lathes combine power and precision for profitable optimum speed turning with negative-rake throwaway insert tools. They're heavier and wider through the carriage than most lathes of their size. Controls are "human engineered" to make a busy operator's job easier and more efficient. Yet they offer every toolroom feature you can name, plus guaranteed accuracy for precision work.

Opportunities in cost-cutting modernization

There'll never be a better time to buy a new lathe, or greater opportunities to reduce costs through equipment modernization. Here are two good reasons:

1. *Throwaway insert tools* are the biggest "break-through" in lathe "economics" in 30 years. Think of what it costs you to sharpen, change, and reset conventional tooling! Throwaway inserts make your perishable tool costs so low in relation to part costs and the cost of operating a machine, the only sensible thing to do is boost speeds, burn up tools faster, and reduce floor-to-floor time.

2. *It's the right time to buy machine tools*, because you can "pick and choose" — get the right machine and tooling for your assortment of jobs. The increase in productivity will prepare your plant for periods of high volume, spiraling costs, and labor shortages tomorrow.

Now in production in two sizes, these new machines will pull 25 hp through the spindle and operate at speeds up to 2000 rpm.

Barber-Colman Company
92 Loomis Street, Rockford, Illinois

Don't expect a day's work for a day's pay on yesterday's machine tools.

BARBER COLMAN®

PRECISION LATHES

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

new

BARNESDRIL HONING TOOL

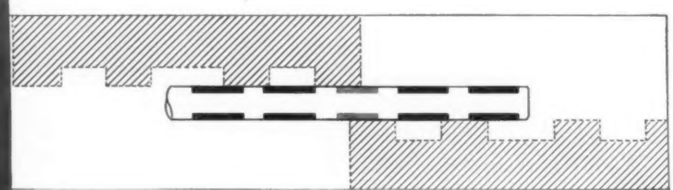
guarantees parallelism concentricity alignment in finishing

INTERRUPTED BORES

This new style BarnesdriL honing tool is designed for constant alignment-bearing while cutting throughout the length of interrupted bores. Designed with one bank of 4 BarnesdriL Plas-T-Clad Honing Stones, the tool has two banks of 3 fiber guides each in front of the stones, and two banks in back of the stones. These guide assemblies are automatically expanded with the stones, keeping the tool firmly supported at all points, to meet the conditions of the bore.

As a result, alignment of all segments of the bore is assured, and any tendency for "bell mouth," characteristic of interrupted bores, is eliminated. The honing tool is equipped with a universal drive shank, and will hone a range of bores within certain limits.

Sketch indicates extreme cutting position at either end of bore length, showing how tool is fully supported with at least two bearing points in any cutting position.



The application sketch shown here represents the honing operation on a rotor sleeve which is actually a series of bores within the part. This tool maintains tolerances of $\pm$.00025", removing .004" stock from interrupted bore sections, .875" diameter by 8.750" overall length. Finish requirements are 40 RMS.

With knowledge of the job requirements, BarnesdriL engineers are able to furnish honing tools and abrasives with maximum cutting efficiency for all honing operations. If you have special finishing problems or bore applications, send prints or sample parts for recommendations by BarnesdriL engineers. Estimates will be furnished without obligation.

Write for bulletin completely describing new designs in Honing Tools and Abrasives. Ask for Bulletin No. 570.

HOLE BARNESDRIL FINISHING

BARNES DRILL CO.

820 CHESTNUT STREET • ROCKFORD, ILLINOIS

DETROIT OFFICE: 13121 Puritan Avenue

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

New VICKERS® Electro-Hydraulic Servo Valve

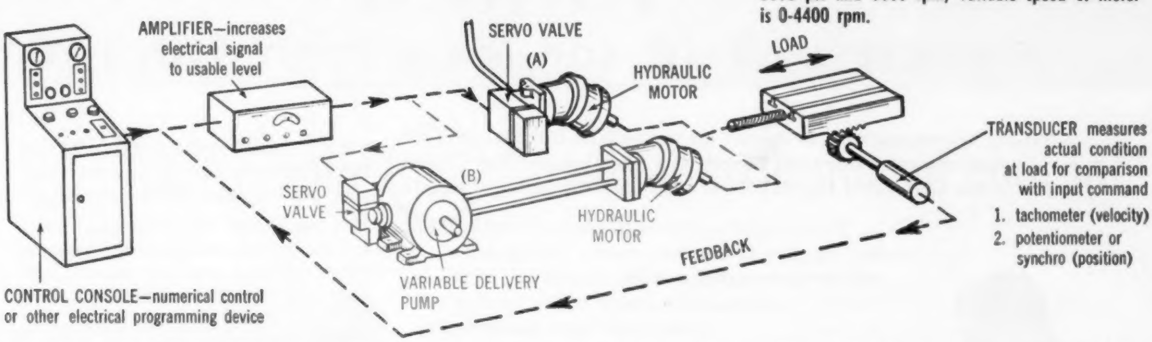
has numerous advantages for industrial use:

- ***Extremely Accurate***
- ***Simple • Rugged • Dependable***

This valve provides a simple, dependable means of translating control signals from electronic programming into extremely accurate modulated flow of hydraulic power for fast and precise closed loop control of position, velocity and acceleration. Performance has been proven on machine tools, industrial processing equipment and ground ordnance applications.

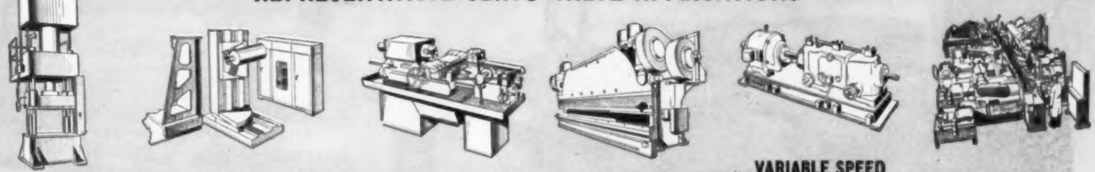
Simplicity and reliability are exceptional . . . only four moving parts are required. Mechanical feedback linkage with unique variable fulcrum provides optimum flexibility for various conditions of flow, response and pressure. For further information, write for Vickers Engineering Bulletin 58-74.

Vickers Electro-Hydraulic Servo Valve integrated with piston type hydraulic motor provides a minimum amount of oil under compression. Integral cross line relief valves are provided as well as variable cross line orifice for controlling viscous damping. This "package" can provide approximately 20 hp @ 3000 psi and 3600 rpm; variable speed of motor is 0-4400 rpm.



Now the flexibility of electronic control can easily be applied to versatile hydraulic power. Vickers new industrial electro-hydraulic servo valve is used (A) to directly regulate the oil to an actuator (valve motor system). Shown in blue is an alternate application (B) for higher flows when the valve controls a variable volume pump (servo pump system).

REPRESENTATIVE SERVO VALVE APPLICATIONS



PRESS
Ram velocity controlled accurately during all cycles.

MILLING MACHINE
Precision control of velocity, position and acceleration of slides and tables.

LATHE
Exact feed rate and position control of cutting tool.

PRESS BRAKE
Cylinders synchronized precisely.

VARIABLE SPEED DRIVE
Accurate velocity control of spindle speeds for test stands or machine tools.

PROCESS LINE
Programmed control of Material Handling and machine sequencing.

8126

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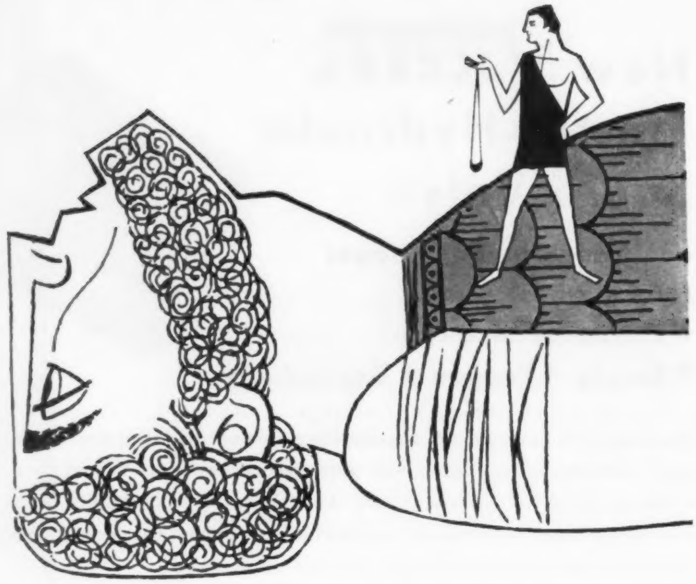
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

For more info on any products advertised this issue use card, page 201

why use GOLIATH when "DAVE" can do the job at 1/2 the cost?

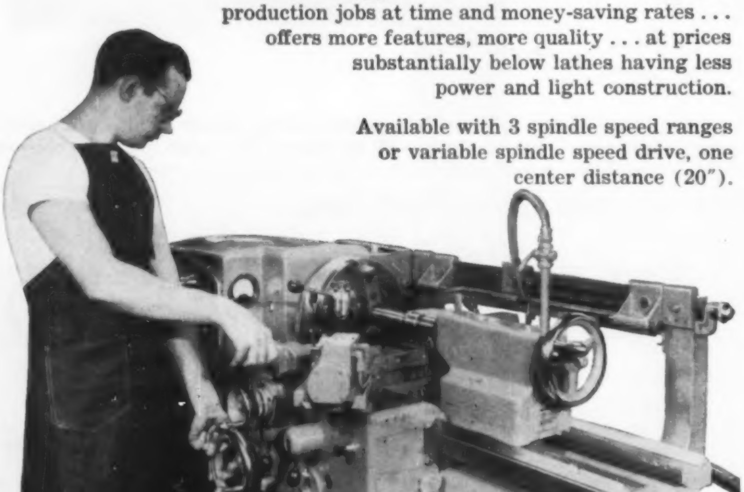


don't pay $20,000 when you can buy a LODGE & SHIPLEY Hi-Turn COPYMATIC TRACER LATHE for less than $10,000

A too-big, too-expensive tool doesn't mean you'll do the job quicker, better or at lower cost. There's new proof of that fact . . . in the 1307 (10") HI-TURN 45° COPYMATIC Tracer Lathe!

This rugged and versatile lathe is built to do production jobs at time and money-saving rates . . . offers more features, more quality . . . at prices substantially below lathes having less power and light construction.

Available with 3 spindle speed ranges or variable spindle speed drive, one center distance (20").



"EXCELLENT FOR HIGH PRODUCTION ON SMALL PARTS," says Indiana Gear Works, Indianapolis

This well-known precision gear manufacturer has a number of Lodge & Shipley lathes in a busy plant. The latest is a Hi-Turn COPYMATIC, evaluated as follows:

SPEED RANGE:
"The wide range of speeds available on this machine is definitely an advantage."

FEED RANGE:
"We are able to select the correct feed for all parts run on the machine."

DINABRAKE MOTOR:
"Speeds production."

HP AMMETER:
"Enables the operator to run the machine at full capacity."

DESIGN:
"Compact, provides ease of set-up."

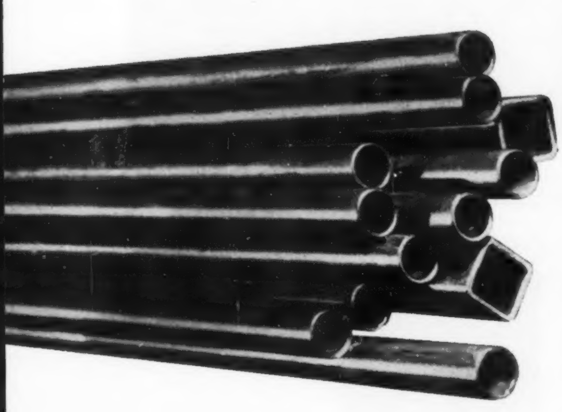
ACCURACY:
"Good."

For complete details, request Bulletin DM-4 from:

The Lodge & Shipley Co.
3057 Colerain Ave.
Cincinnati 25, Ohio

"Whom do I call for mechanical tubing?"

"Why, your USS Shelby Distributor, of course!"



When a steel tubing problem confronts you, get in touch with your Shelby* Distributor. His ideas, experience and engineering know-how will prove most valuable.

Your Shelby Distributor carries a complete stock of USS* Shelby Seamless Mechanical Tubing—round, square, rectangular, or other special shapes in commercial sizes from 1/4" OD to 10 3/4" OD. Wall thicknesses from .035" to 2.000" in a wide range of steel grades and anneals.

So contact your USS Shelby Distributor. He is experienced, capable and close at hand. He gives speedy, efficient service. Contact him!

"Shelby Tubing is made by the world's largest and most experienced manufacturer of tubular products—National Tube."

National Tube
Division of USS United States Steel

*TRADEMARK

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division
United States Steel Export Company, New York

. . . attained with the New SIP HYDROPTIC 6A Jig Boring and Milling Machine

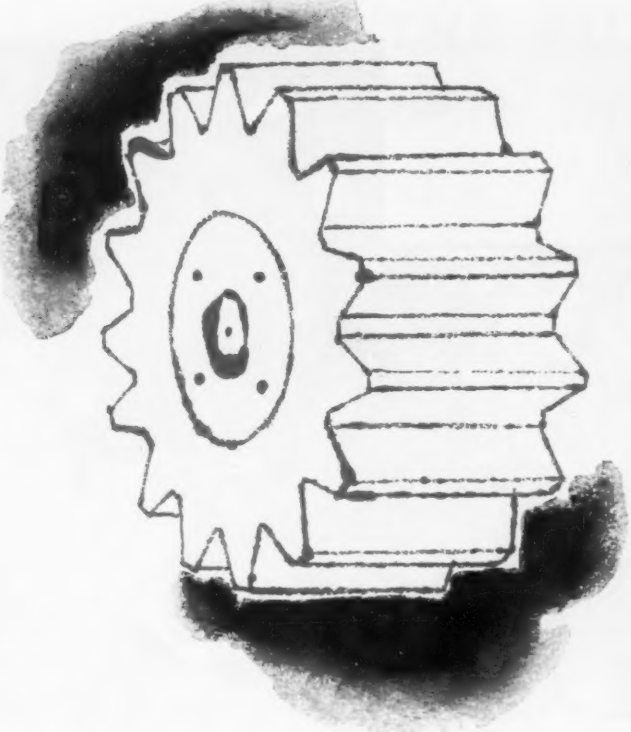
Due to unprecedented cutting ability . . . increased range and capacity . . . simplification of controls . . . and ease of operation, the HYDROPTIC 6A is unmatched in performance.

Up to **30% increase** in productivity has been realized with the AUTOMATIC COORDINATE REPEATING DEVICE DIR (optional equipment) which repeats successively the initial settings made during the machining of the first workpiece.

For complete information, send for Catalog No. 1149.

As with all SIP HYDROPTICS, *accuracy is based on* SIP *High Precision* STANDARD SCALES.

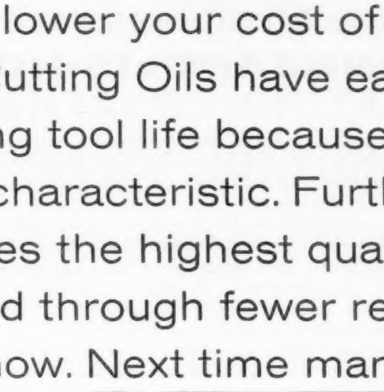
AMERICAN SIP CORPORATION • 100 EAST 42 STREET, NEW YORK 17, N.Y.



Gears... Cutting Oils... and How to Save Money

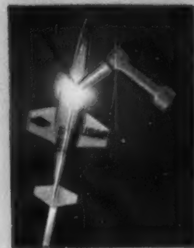
The more gears your equipment can hob before tool change, the lower your cost of operation. Sinclair Ordnance Cutting Oils have earned the reputation for increasing tool life because of their high heat dissipation characteristic. Furthermore, a special E. P. agent assures the highest quality finish . . . more money saved through fewer rejects. Switch to Ordnance, now. Next time management asks how you've cut costs, tell them you've changed to Sinclair—and show them the results.

Call your Sinclair Representative
for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There is no obligation.

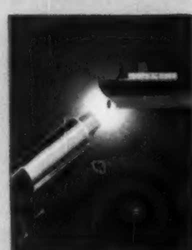


SINCLAIR

Ordnance Cutting Oils



INDUSTRIAL GASES... NATIONWIDE... FROM AIRCO



Air Reduction gases, among them oxygen, nitrogen, argon, hydrogen, helium and carbon dioxide are vital commodities in the metal-working industries.

In other industries, too, Air Reduction gases are playing an important role—food processing, electronics, steel, aircraft and missiles, and chemicals.

To all industries, Air Reduction supplies gases in whatever quantity needed, and in whatever form—gaseous or liquid. (Except hydrogen—available in gaseous form only and helium also available in liquid form currently on West Coast only, elsewhere in gaseous form.) Air Reduction industrial gas specialists, with years of practical experience and technical training, are at your service to help you make the most efficient use of industrial gases. Ask the Airco representative in your vicinity to show you why your gas requirements are best served by Air Reduction.

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All divisions or subsidiaries of Air Reduction Company, Inc.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: **AIRCO** – Industrial gases, welding and cutting equipment • **AIRCO CHEMICAL** – vinyl acetate monomer, vinyl stearate, methyl butynol, methyl pentynol, and other acetylenic chemicals • **PURECO**—carbon dioxide—gaseous, welding grade CO_2, liquid, solid ("DRY-ICE") • **OHIO**—medical gases and hospital equipment • **NATIONAL CARBIDE**—pipeline acetylene and calcium carbide • **COLTON**—polyvinyl acetate, alcohols, and other synthetic resins.

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AND RARE
GASES

OXYGEN
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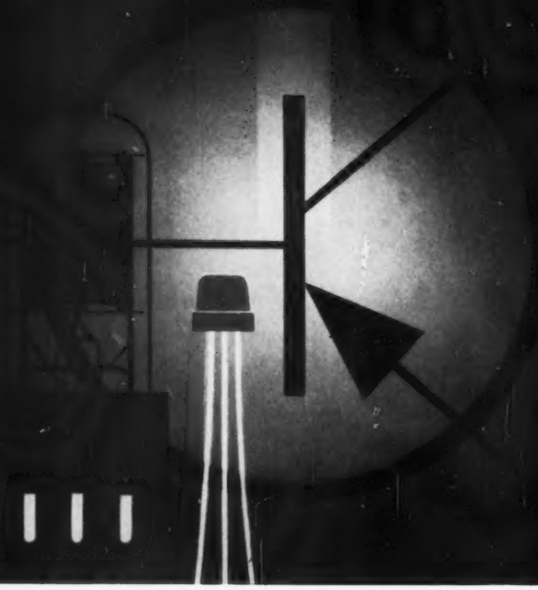

in electronics . . . Air Reduction gases provide the right environment

One of the significant uses of Air Reduction gases is in the creation of special "environments" wherein a delicate production or testing operation may take place. For example, in electronics, germanium and silicon crystals for transistors are "bred" in atmospheres of Air Reduction nitrogen or argon with purities of 99.995%.

The electronics industry also utilizes the refrigerating properties of Air Reduction liquid nitrogen to create *low temperature environments* for production. Electronic tubes are flushed with nitrogen and filled with argon, nitrogen or argon-nitrogen mixtures to create an oxygen-free environment. And oxygen, in turn, is used in photo flash bulbs where a combustion-supporting atmosphere is needed.

Air Reduction produces all of these industrial gases and also hydrogen, xenon, krypton and neon. If you use industrial gases for any purpose, Air Reduction's Technical Service Organization will help you work out economical and efficient applications. There is an Airco office near you.

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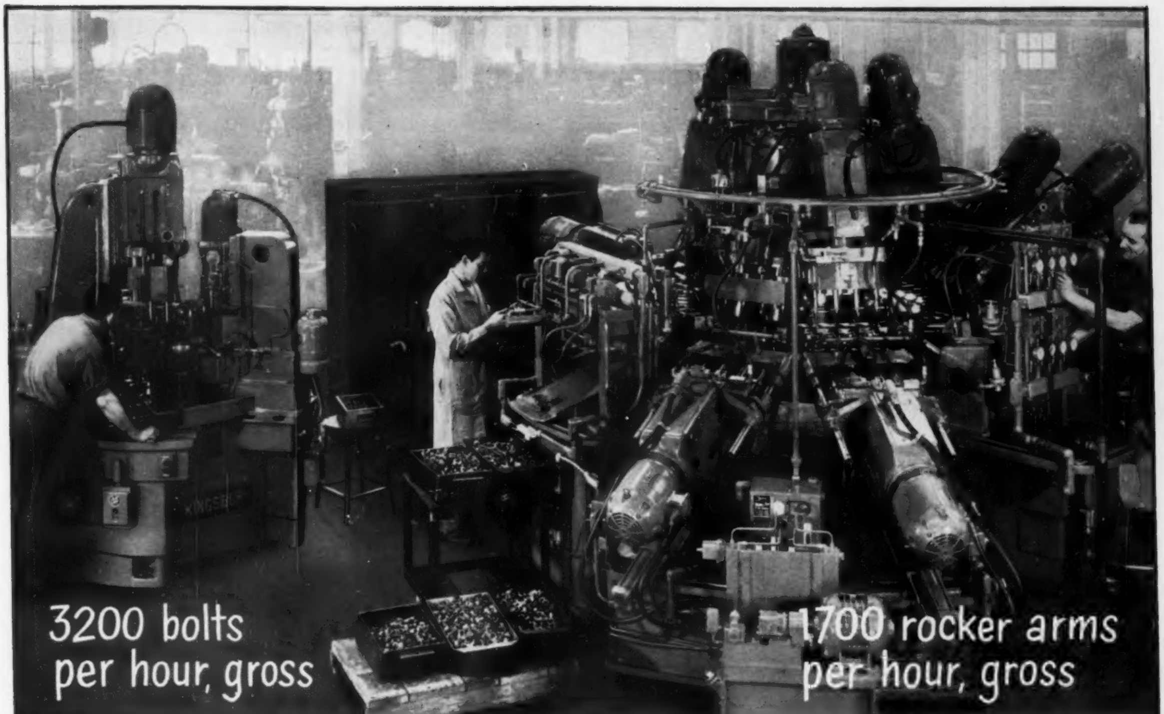
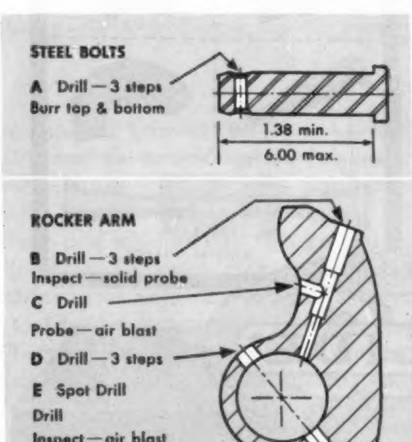


On the left — a ten-spindle Kingsbury. It completes two bolts every 2.2 seconds (including indexing). The big unit has a three-spindle auxiliary head and drills hole A in three steps at three stations. Each small unit has an underneath attachment and burrs one part top and bottom. Parts are ejected onto a chute between these burring units.

On the right — a 56-spindle Kingsbury with center column. It completes four rocker arms every 8.5 seconds (including indexing). All units have four-spindle auxiliary heads with oil mist lubrication. Units on the center column operate on hole B. Units on knees around the base work downward on holes C and D and upward on hole E. The units for hole E have hydraulic slides for more efficient changing of tools.

...talk about high production!



These two Kingsburys have extremely high production rates because they (1) operate on more than one part at a time, (2) have short time cycles by drilling in steps, and (3) automatically clamp, unclamp and eject onto chutes. The machines are on our assembly floor ready to ship. The customers have approved test samples.

One machine is fairly simple, the other complex. But both will continue to produce good parts month after month because they have good basic design and rugged, accurate construction.

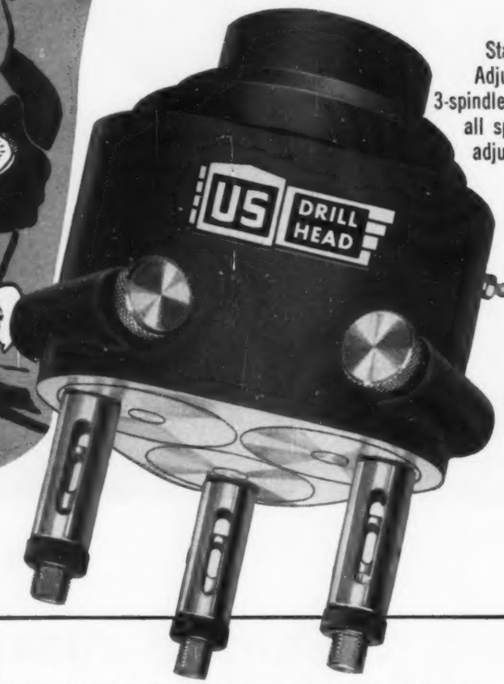
LOWER PRODUCTION RATES

Most Kingsburys produce at rates of 200 to 600 parts per hour. We design each one to meet the customer's requirements. On most machines each fixture holds only one part. Many have manual clamping.

For 38 years we have built machines that our customers don't worry about. May we do the same for you? Kingsbury Machine Tool Corporation, Keene, New Hampshire.

KINGSBURY

LOTS OF HOLES . . . *FAST?*



Standard Adjustable 3-spindle head, all spindles adjustable.

For two, three or four spindle drilling you can do it better, faster, at lower cost with U. S. Standard Adjustable Heads. *At the TOP in productive performance—at the BOTTOM in overall cost.*

Designed and built with more reserve stamina than you'll ever need . . . antifriction bearings . . . high alloy steel spindles and shafts . . . heat treated and shaved gears . . . more than ample spindle bearing . . . parts run in light lubricant (oil-mist available for speeds around 4000 rpm).

Write for catalog AD-57, showing the complete line of Standard and Universal Joint Adjustable U. S. Drill Heads.

Five styles of Standard Adjustable Heads include:

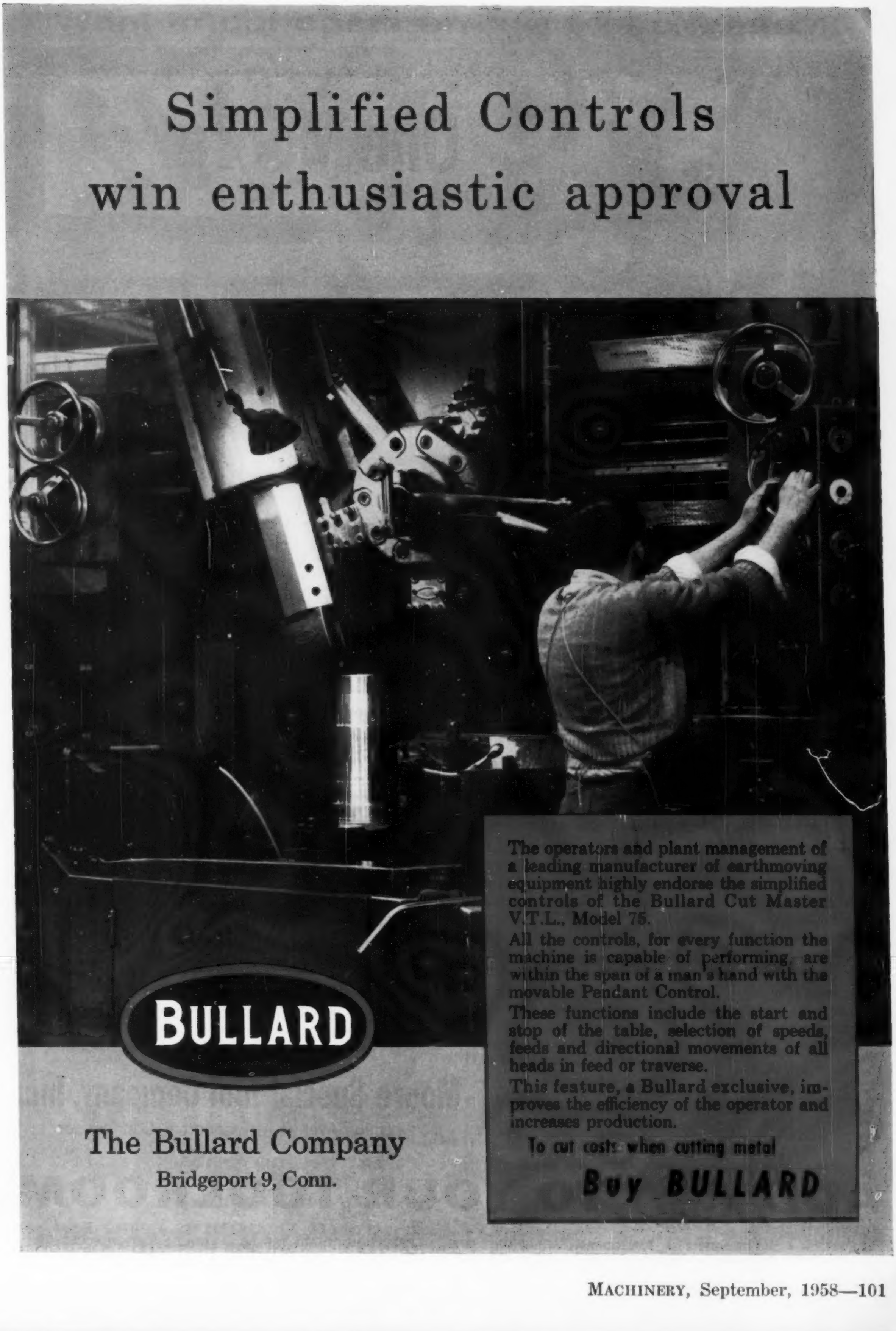
- Two-spindle, 1 adjustable—9 sizes up to 5.5" max. center distance, 1/4" to 1" drills.
- Three-spindle, 2 adjustable—12 sizes, up to 6.9" max center distance, 1/4" to 1 3/8" drills.
- Two-spindle, both adjustable—12 sizes, up to 12.0" center distance, 1/4" to 1 3/8" drills.
- Three-spindle, all adjustable—12 sizes, up to 13.4" bolt circle, 1/4" to 1 3/8" drills.
- Four-spindle, all adjustable—12 sizes, up to 15.2" bolt circle, 1/4" to 1 3/8" drills.

US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

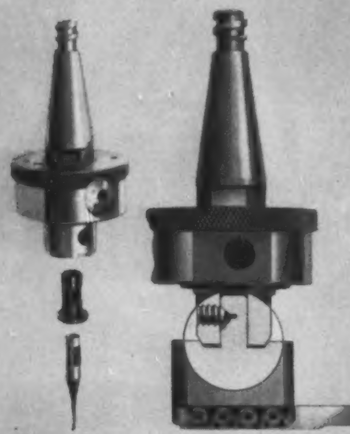
BURNS STREET • CINCINNATI 4, OHIO



Simplified Controls
win enthusiastic approval
BULLARD
The Bullard Company
Bridgeport 9, Conn.
The operators and plant management of a leading manufacturer of earthmoving equipment highly endorse the simplified controls of the Bullard Cut Master V.T.L., Model 75.
All the controls, for every function the machine is capable of performing, are within the span of a man's hand with the movable Pendant Control.
These functions include the start and stop of the table, selection of speeds, feeds and directional movements of all heads in feed or traverse.
This feature, a Bullard exclusive, improves the efficiency of the operator and increases production.
To cut costs when cutting metal
Buy BULLARD

One Moore Boring Chuck Set bores any hole from 5/32″ to 5″

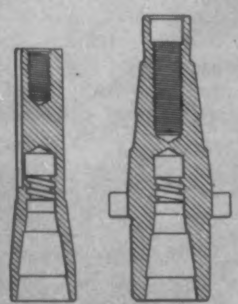
Packaged Set
includes boring chuck, reducer bushing, extension bar and tool bits.



How it works

Holes from 5/32″... Note 1/2″–3/8″ reducer bushing for either 1/2″ or 3/8″ shank holes.

To 5″ holes... Here 1/2″ shank is merely a drawback to use nose end of chuck for stiffness.



Bridgeport Millers
can utilize Moore Boring Chuck Set by means of shank adapter at left. Another Moore adapter (right) fits machine spindles with No. 40 tapers.

Here's an ideal way to hold down your investment in boring machine accessories. The unique Moore Boring Chuck Set is like three sets in one... boring the complete range of holes from 5/32″ to 5″. And with just one chuck for both tool bit shank sizes, you save chuck-changing time, too.

Dependable Moore-quality workmanship and design show in every detail of the chuck and tool bits. To insure years of accurate use, all chuck components, including the adjusting lead screw, are hardened and ground. The chuck is completely dust-protected, and its large, clear dial has 50 graduations...increases hole .001″ in diameter per graduation. The chuck will start behind center for small holes and move to 3/8″ plus. It's easy to unclamp, move and reclamp slide in exacting increments. One wrench fits all screws. The tool bits are available in either high speed steel or carbide-tipped.

And here's the best news of all! Originally designed for use with Moore Jig Borers only, this completely packaged boring unit can now be purchased with appropriate shank adapters to permit its use with all Bridgeport Millers or any machine with a No. 40 Taper.

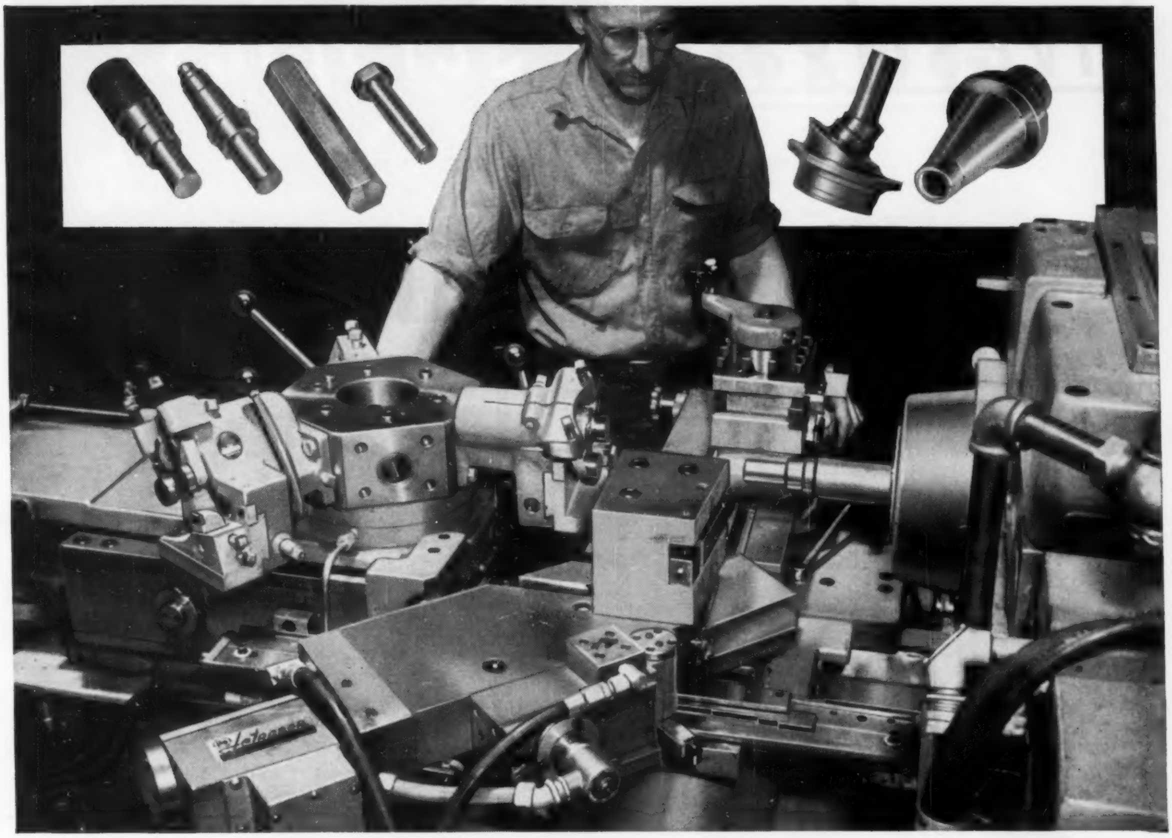
For further information and complete ordering instructions, just drop a line to...

Moore Special Tool Company, Inc.
734 Union Avenue, Bridgeport 7, Connecticut

ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES

Want to cut costs on parts like these?



Here's how tracing will help you save

The simple, basic setup shown above handles nearly 300 different parts for a well-known manufacturer of drive line components. All work is performed on one Gisholt MASTERLINE No. 4 Ram Type Turret Lathe with a JETracer on the rear of the cross slide. Standard tools on the hex and square turrets are used to face, chamfer and reduce the stock while the JETracer finishes all diameters, steps, blends and radii. The 6$\frac{9}{16}$"-long, 2"-diameter stepped shaft (above at left) is typical and is completed in two operations with total f.t.f. time only 4.95 minutes.

Here are just a few things the JETracer can do for you:

- Shorten setup and change-over time
- Simplify machining and eliminate operator errors
- Save cost of form tools, multiple tool blocks and holders
- Reduce inspection time (only one length and one diameter need checking)
- Minimize or eliminate secondary operations (through finer finish, greater accuracy)
- Increase production through automatic machining of complex surfaces
- Free operator to handle extra units or perform other work

Gisholt has developed a complete line of JETracers for use with ram and saddle type turret lathes, automatic turret lathes and single-spindle chucking lathes. These include rear cross slide, turret and independent slide mounted units, single or multi-pass types. *All are designed to operate at full capacity of the machines to which they are applied, without limiting machine functions or restricting the use of standard tools.*

You'll want to see for yourself how the JETracer adds flexibility, speeds operations and cuts costs on standard and problem parts. Send the coupon today for your free copy of the new JETracer catalog, or call your Gisholt Representative for complete information.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE

Gisholt Machine Company
1209 E. Washington Ave.
Madison 10, Wisconsin

Please send a copy of the new Gisholt JETracer catalog.

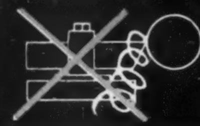
Name.............................. *Title*..........

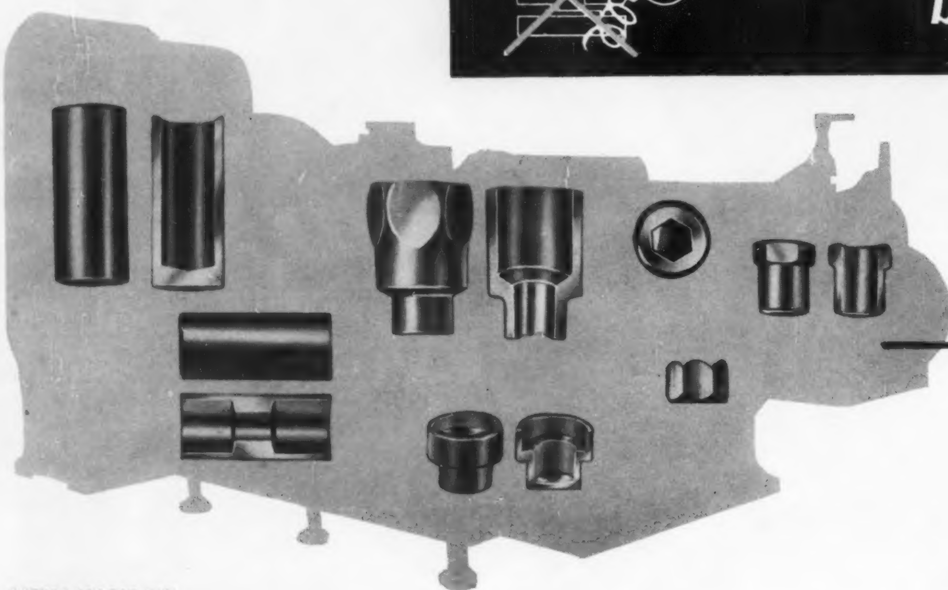
Company..

Street address..

City...................... *Zone*...... *State*...........

Investigate "Scrapless" by





NEW WAY TO

- Increase Production
- Eliminate Secondary Operations
- Increase Tensile Strength
- Hold Close Tolerances
- Lower Material Costs
- Cut Scrap Loss

Here are some actual examples of production savings and improvements achieved by Waterbury Farrel Parts Formers.

PRODUCT: POWER ELEMENT CUP
MATERIAL: DE-OXIDIZED COPPER

OLD METHOD

Formerly produced in two parts on Eyelet Machines from strip metal. Production ran about 55 parts a minute and scrap approx. 17 lbs. per 1,000 completed pieces.

WEIGHT OF 1000 PIECES APPROX. 25 LBS.

NEW METHOD

Part is now made in one piece on the PARTS FORMER. Assembly is eliminated, there is no scrap and production has gone up to 100 parts per minute.

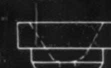
PRODUCT: VALVE SEAT
MATERIAL: SAE 1018 STEEL

OLD METHOD

Using rectangular strip and progressive tools, this part was made on a press. Scrap ran as high as 40%.

WEIGHT OF 1000 PIECES APPROX. 13 LBS.

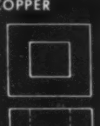
NEW METHOD



A PARTS FORMER, using round wire, reduced scrap to 1/4 lb. per 1000 pieces or approx. 98% savings. 85 valve seats are produced a minute.

PRODUCT: SHADING COIL
MATERIAL: COPPER

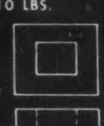
OLD METHOD



Produced on presses from specially rolled rectangular strip. Required tolerances meant 100% trimming. Approx. 8 lbs. of scrap was also produced in 1000 parts.

WEIGHT OF 1000 PIECES APPROX. 10 LBS.

NEW METHOD



Scrap was reduced to 1½ lbs. per 1000 pieces. A savings in raw material was also effected by the use of round wire. The PARTS FORMER is producing 125 parts per minute.

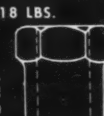
PRODUCT: 5/16" TUBE NUT
MATERIAL: AISI 1108 STEEL

OLD METHOD

Produced on screw machines from hexagon bar stock. Scrap amounted to approx. 28 lbs. per 1000 pieces. Was also made on a Crank Eyelet type machine at a speed of 50 nuts a minute, with scrap slightly less.

WEIGHT OF 1000 PIECES APPROX. 18 LBS.

NEW METHOD



Using round wire, the PARTS FORMER is producing 100 nuts per minute. Scrap is reduced to 3 lbs. per 1000 pieces. A savings of approx. 90% in raw material.

For more info on any products advertised this issue use card, page 201

Albany 1, N. Y.
Eastern Metals Warehouse, Inc.
ALbany 89-3281

Birmingham 5, Ala.
Allegheny Ludlum Steel Corp.
FAirfax 3-0548

Buffalo 7, N. Y.
Brace-Mueller-Huntley, Inc.
Victoria 8700

Cambridge 38, Mass.
Achorn Steel Company
HAncock 6-9592

Charlotte 1, N. C.
Edgcomb Steel Company
FRanklin 5-3361

Chicago 32, Ill.
Allegheny Ludlum Steel Corp.
LAfayette 3-8650

Chicago 32, Ill.
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CEdar 4-6672

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Good Steel Service, Inc.
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Warehouses stocking Allegheny Ludlum's Tool and Die Steels are located conveniently throughout the country. There's one near you. Jot down its phone number and call the next time you have a problem or need steel.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.
ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Building, Pittsburgh 22, Pa. Address Dept. M-9.

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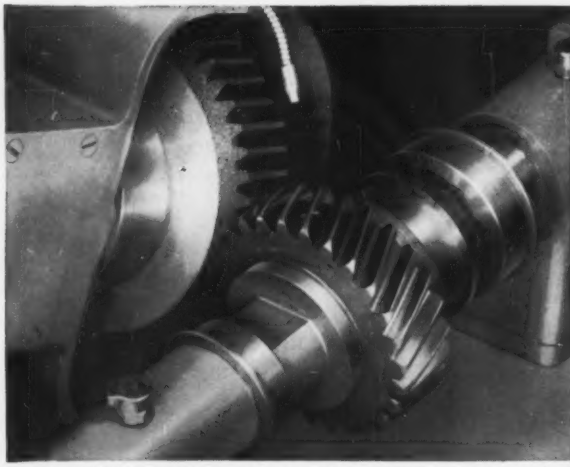
Tool Steel warehouse stocks throughout the country . . . Check the yellow pages

every grade of tool steel . . . every help in using it

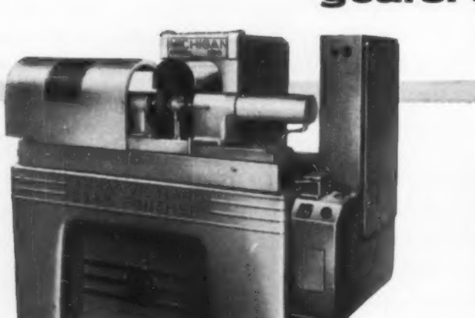


The finishing action—an abrasive tool rotates in tight mesh (and drives) the hardened work gear in a crossed-axes relationship. The table traverses the work the full face width.

Grit content of the abrasive-plastic tool varies with application. Relatively inexpensive, the throwaway tools actually become even more accurate as they "wear in".

Announcing HARD GEAR FINISHING...

... new process removes nicks and surface imperfections after heat treating to give you quiet, smooth-running gears. Uses long-life throwaway tools to slash rejections



Abrasive Hard Gear Finisher (Model 999), a compact, functionally styled machine cleans up and silences hard gears in about one minute. With horizontal axes, the finisher is easily tooled for semi- or full-automatic operation. An integrated gear speeder and/or crowning attachment are optionally available with the machine.

Now you can obtain consistent quietness and smoothness on your hardened small- and medium-sized gears (up to 12-inches diameter). Michigan Tool's Abrasive Hard-Gear Finisher does the job quickly and effectively at low cost. It uses amazingly long-life abrasive-impregnated tools to remove nicks and burrs, improves finish, and tightens dimensional accuracy by further refinement after heat treat. It all adds up to quiet, lower cost gears. Full details in Bulletin 999. Write for it.

MICHIGAN TOOL Company

complete from blank to finished gear equipment

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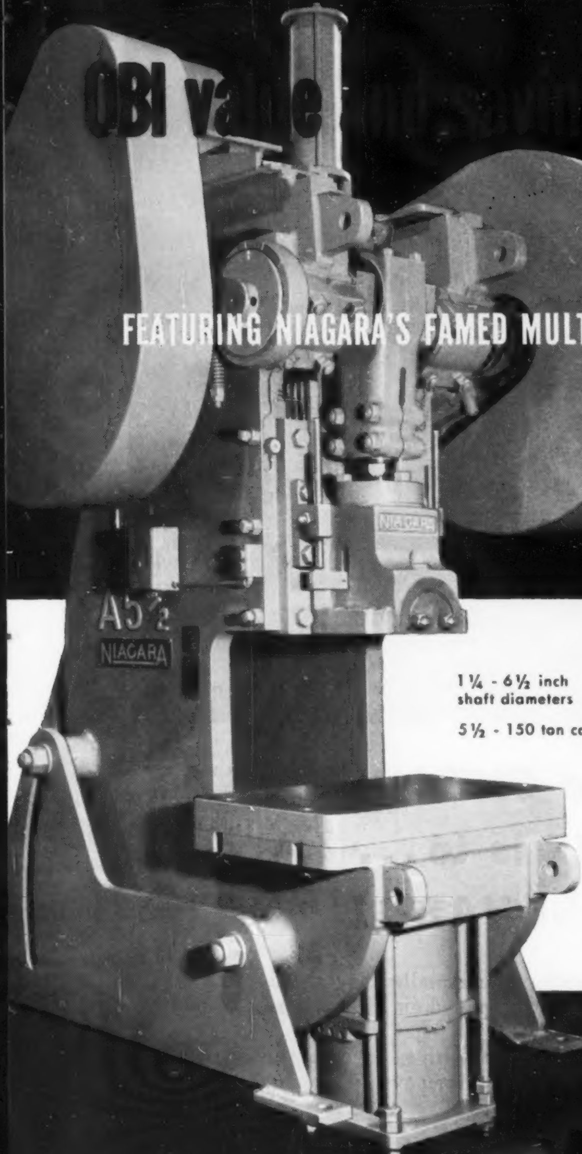
IN CANADA: COLONIAL TOOL CO. LTD.

TON FOR TON . . . DOLLAR FOR DOLLAR



FEATURING NIAGARA'S FAMED MULTI-POINT MECHANICAL SLEEVE CLUTCH

Picks up load on 14 engaging jaws. Applies driving force concentrically without keys or pins. Assures instant engagement and maximum productive strokes per minute. Needs no air nor electricity. Practically no maintenance. Greater safety: Simplified controls, fewer parts to wear out. *Yes, it permits, inching, too.*

1¼ - 6½ inch shaft diameters

5½ - 150 ton capacities

Here's a workhorse that's known for setting the pace on the most demanding jobs . . . jobs where the clutch is engaged and disengaged at every press stroke . . . jobs that call for operation three shifts a day, day in and day out.

Built and *backed* by a company which produces industry's greatest variety of inclinables*, Series A Presses have amassed an unusual success record in thousands of applications. To be specific, let's take a close look at a Series A user:

28 OBI'S SINGLE STROKED 707,140,000 TIMES WITHOUT ONE CENT SPENT ON CLUTCH ENGAGING SURFACES

GET THE FULL REPORT

NIAGARA

OBI PRESSES

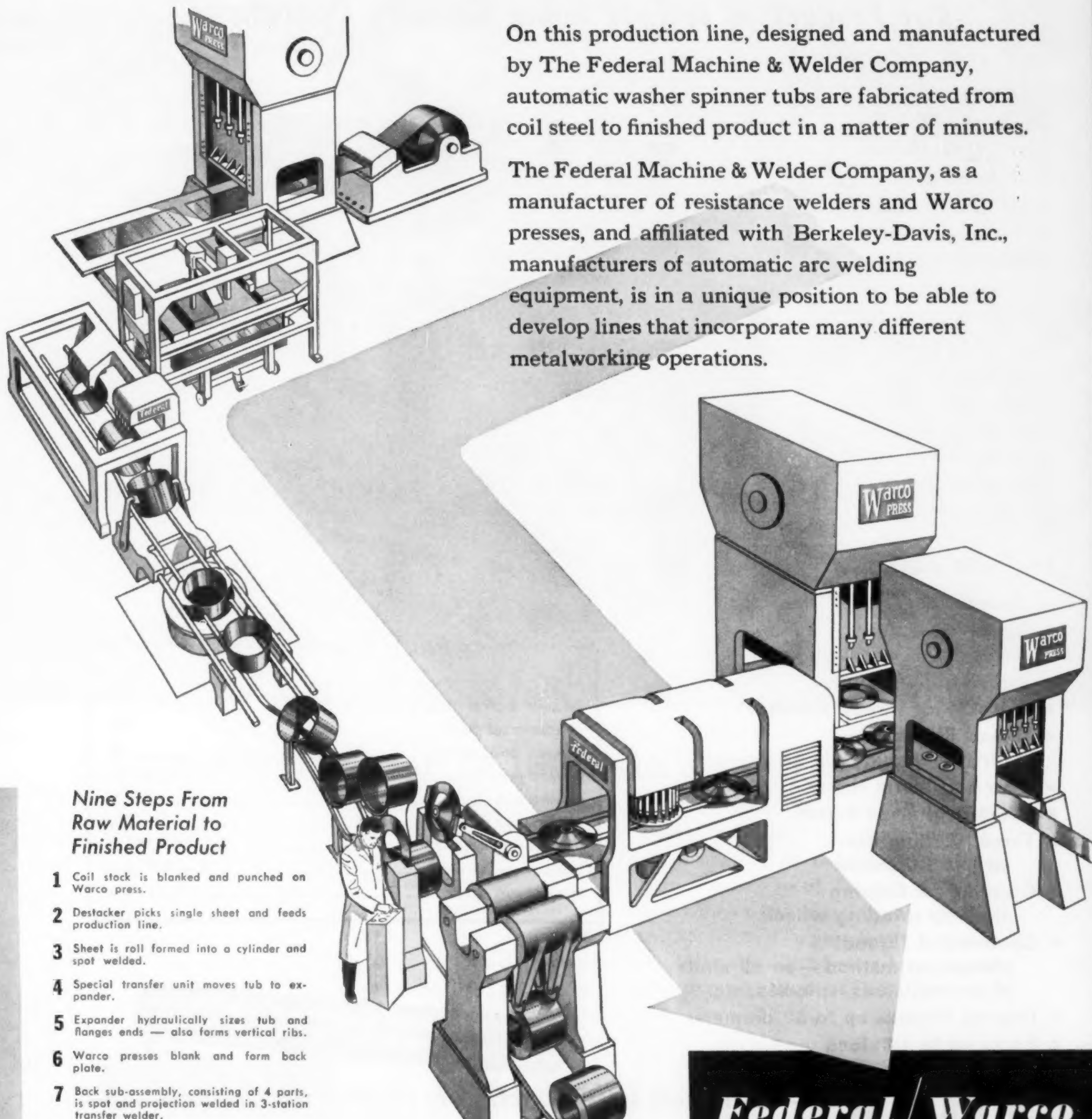

20 MINUTES
10 MINUTES
8 MINUTES

THE ACCENT IS ON PRODUCTION

in a production line by FEDERAL

On this production line, designed and manufactured by The Federal Machine & Welder Company, automatic washer spinner tubs are fabricated from coil steel to finished product in a matter of minutes.

The Federal Machine & Welder Company, as a manufacturer of resistance welders and Warco presses, and affiliated with Berkeley-Davis, Inc., manufacturers of automatic arc welding equipment, is in a unique position to be able to develop lines that incorporate many different metalworking operations.



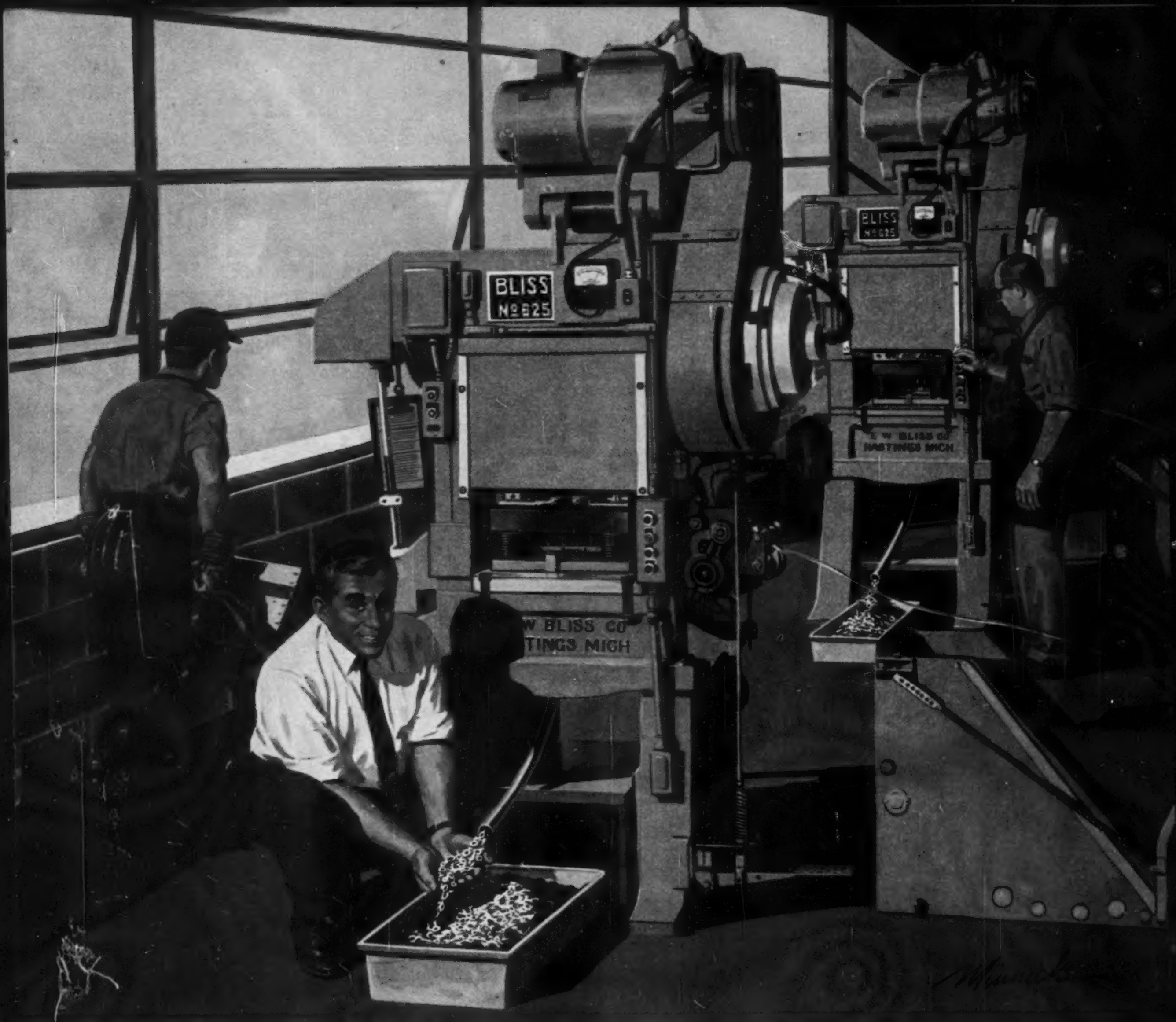
Nine Steps From Raw Material to Finished Product

1. Coil stock is blanked and punched on Warco press.
2. Destacker picks single sheet and feeds production line.
3. Sheet is roll formed into a cylinder and spot welded.
4. Special transfer unit moves tub to expander.
5. Expander hydraulically sizes tub and flanges ends — also forms vertical ribs.
6. Warco presses blank and form back plate.
7. Back sub-assembly, consisting of 4 parts, is spot and projection welded in 3-station transfer welder.
8. Front plate and back assembly are automatically positioned and inserted into body.
9. Double end seamer lock seams front plate and back assembly to body and ejects finished tub.

* Sequence of operations controlled by static relay system designed and built by Federal.

Federal / Warco
PACKAGED PRODUCTION LINES

THE FEDERAL MACHINE AND WELDER COMPANY, WARREN, OHIO
Affiliated with Berkeley-Davis, Inc., Danville, Illinois



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KNUCKLE JOINT PRESSES

FOR AUTOMATIC FEEDS OR CUSTOM WORK

Whether equipped with multi-station feed for automatic production or doing custom work, Cleveland Knuckle Joint Presses exert a short but extremely powerful squeeze on the metal through massive, carefully fitted knuckles operating on shafts of hammered steel forgings.

Greater accuracy of production is obtained with these Cleveland Presses due to the long slide bearing surfaces and rugged frame construction featuring four massive tie rods. These control slide deflection to a minimum even under maximum load.

With capacities from 150 to 3000 tons and bed areas from 18 x 18″ to 50 x 54″, Cleveland Knuckle Joint Presses are engineered to do the job efficiently, economically. Investigate the cost-cutting advantages of these Cleveland Presses by writing for Catalog K2 today. AA-8149

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Established 1880

Power Presses
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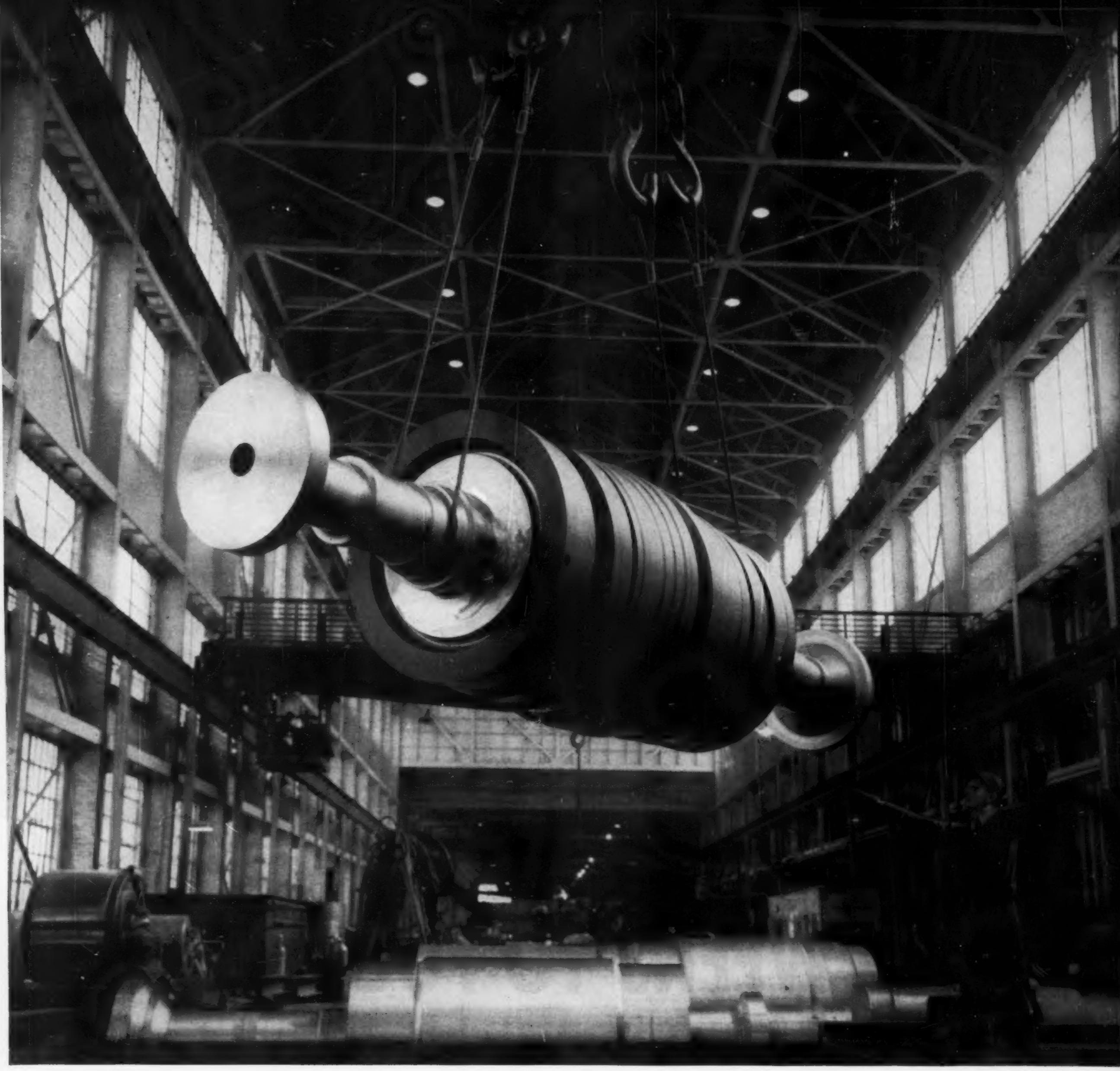

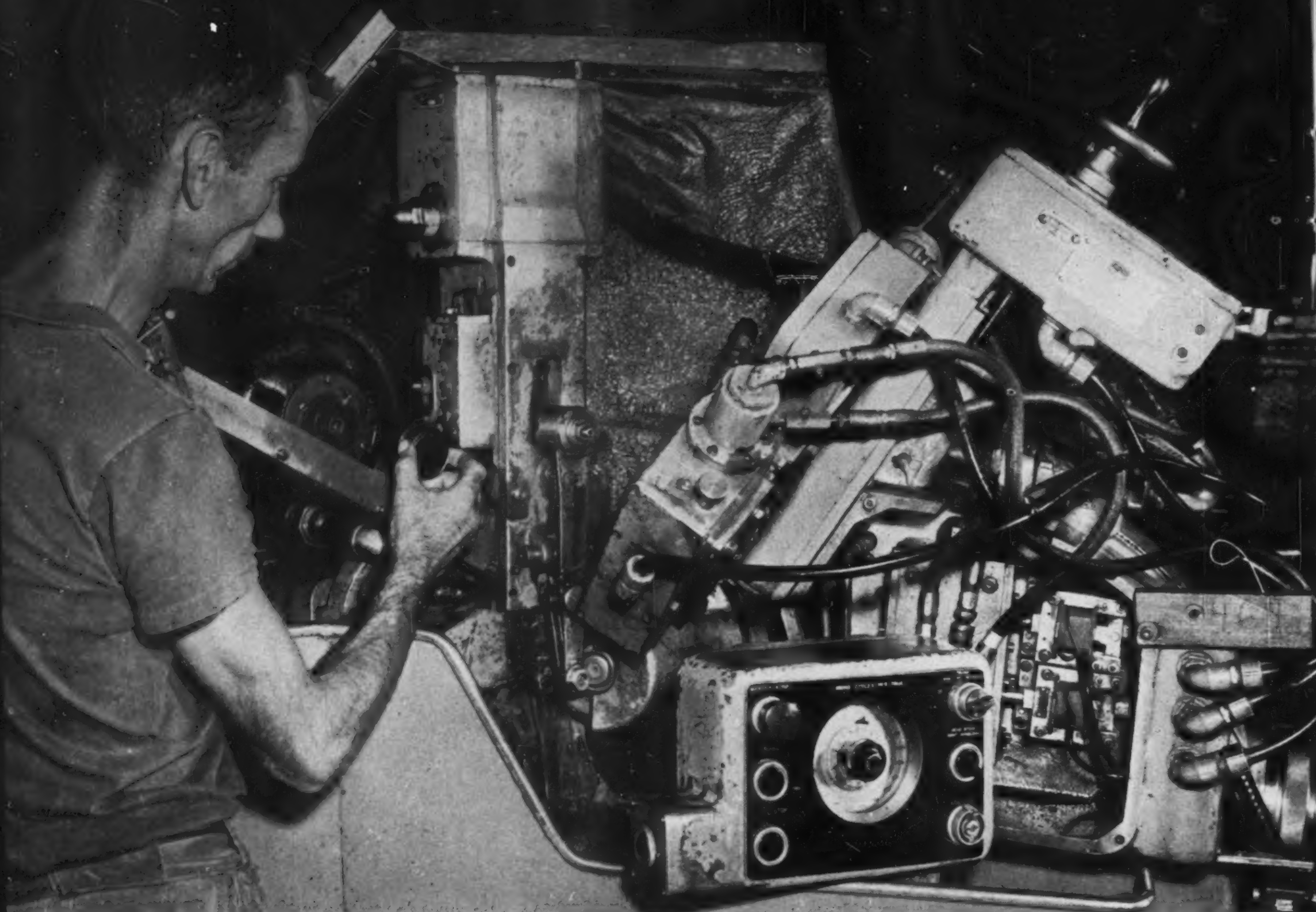

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- **Accelerated Depreciation Favored**
- **Small Business "Fair-Haired Boy"**
- **Bulletin "F" Revision Simmers**

Keeping up with Washington

Loring F. Overman

THE RECESSION, Sputnik, and Iraq have combined in recent months to stymie all hope of any extensive tax revision at this session of Congress. Instead, the Budget Bureau is struggling with increasing deficits and the strong probability of heavier emergency spending. Consequently, the Treasury is on the lookout for additional, not reduced income.

Major Tax Overhaul Prerequisite

Machinery folk, voicing their views through the Machinery and Allied Products Institute, hope to convince the next session of Congress that a major tax overhaul to encourage capital investment is prerequisite to the continued growth of the country, and to industry's ability to step up its tax contributions.

MAPI's belief in the seriousness of the problem and in the vital importance of prompt action is summarized in a just-published presentation, "The Tax Depreciation Problem." It is to be placed in the hands of legislators and policy makers at every government level. The presentation is also intended to serve as a guide to the machinery industry in planning its strategy toward achieving a major tax overhaul in the next Congress.

The new MAPI study supplements an earlier one, "Realistic Depreciation Policy." Write-off principles included in that study were adopted in major part in the Revenue Code of 1954. Discussing the newest study, MAPI President Charles W. Stewart observed:

"Federal tax reform is not a dead issue merely because, for fiscal reasons, it was decided not to legislate reform this year.

"In our judgment the time is ripe for further liberalization of tax-depreciation policy on a permanent basis, in part as an offset to the present deficiency of historical-cost allowances; in part as a means of speeding up the growth of the American economy.

"If this liberalization does not take the form of an adjustment of depreciation to its current dollar equivalent, it should take the form of a compensatory speed-up of the historical-cost allowances themselves. The history of inflation in this country over the past quarter century indicates that such a speed-up would have required a declining balance write-off between three and four times the straight-line rate.

"We suggest at least a triple declining balance write-off, or alternately, an initial allowance of the British type, sufficient with a double-rate write-off, to accomplish a like result."

Accelerated Depreciation Favored

Need for industry cooperation to urge that the next Congress develop realistic formulas for figuring depreciation allowances for capital equipment was also stressed by Niels A. Olsen, Chief, Metalworking Equipment Division, Business and Defense Services Administration.

"We had hoped," said Mr. Olsen, "that Congress would grant some sort of tax relief at this session. Since congressional leaders have indicated that there will be no such action before adjournment, the next best move is to plan ahead so as to assure prompt and informed action by the next Congress.

"It is particularly important that there be changes in the regulations fixing depreciation schedules for capital equipment. Today a machine—or the product it makes—might become obsolete overnight, despite the fact that the machine itself can deliver many years of service of the type for which it was designed.

"Future prosperity of the capital goods industry will depend upon a tax structure which will encourage business to keep its plant and equipment at top efficiency. Capital goods industries will find it to their advantage to join in presenting this viewpoint to all legislative and regulatory levels of Government."

Small Business "Fair-Haired Boy"

Small business is the intended beneficiary of all but half a dozen of the seventy-odd bills proposing various forms of special tax relief, including limited tax concessions applying to capital equipment. Principal provisions of these bills are summarized in HR 13382, passed on July 21 by the House, and considered certain of favorable action in the Senate, possibly with several amendments.

The bill contains five provisions: (1) to allow a special 20 per cent depreciation deduction up to $2000 in the first year for depreciable assets; (2) to allow a deduction against ordinary income for losses sustained on investments in small business; (3) to extend the net operating loss carryback from two to three years; (4) to increase the accumulated-earnings credit from $60,000 to $100,000; and (5) to permit payment of estate taxes in ten annual installments where the principal assets consist of investments in a small business.

Bulletin "F" Revision Simmers

Revision of Bulletin "F," the Bureau of Internal Revenue's official guide to the useful life of capital equipment, including buildings, appears to be nearing completion. For many months, teams of representatives of the Treasury Department and one hundred different industries have been making and studying recommended revisions in depreciation allowances.

None of the recommendations submitted by the task groups has been made public, and there are indications that action has been held up because of controversies over provisions for accelerated depreciation privileges.

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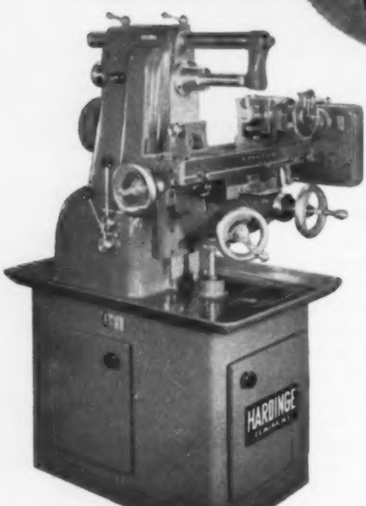

RESEARCH WORK *Demands* THE BEST IN MACHINE TOOLS

HARDINGE is the only manufacturer of companion precision machines for milling, straight turning, taper turning, boring, threading and facing with the feature of interchangeable collets, nose fixtures and attachments.

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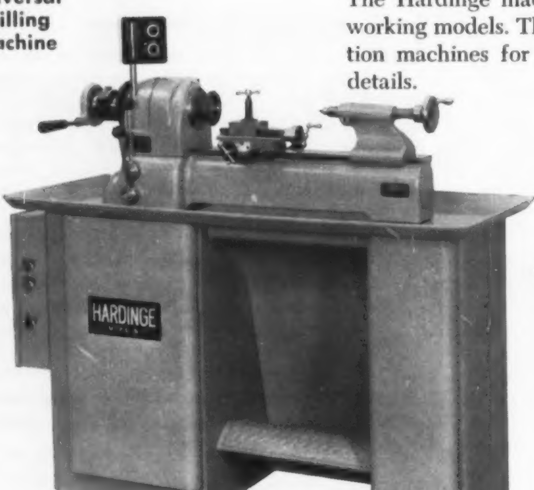
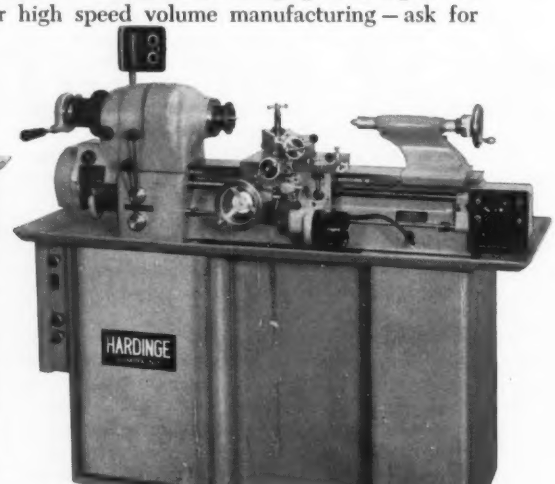


Model DV59 Precision Lathe



Model HLV High Speed Tool Room Lathe

SPECIFICATIONS: *The UM Universal Milling Machine has cutter spindle and spiral dividing head collet capacity of 1-1/16" and a 25 x 6-1/2" swivel table. The DV59 Precision Lathe has 1-1/16" capacity and 9" swing with 17" between centers distance. The HLV Tool Room Lathe has 1-1/16" capacity and 11" swing with 18" between centers distance.*

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Progress on Tax Depreciation

THERE is little likelihood that any action toward liberalizing tax depreciation on capital equipment will be taken by the present Congress. This conclusion is naturally a disappointment after all the agitation in recent months by the business press and various trade organizations. However, definite progress has been accomplished toward eventual serious consideration of the problem by the legislative branch of the government.

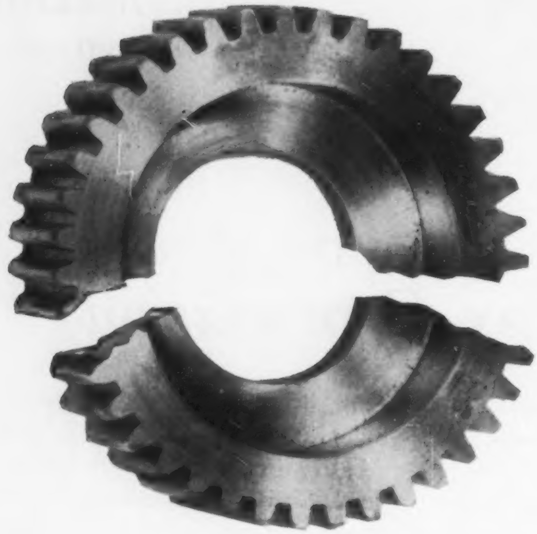
No fewer than seventy-four bills (at last count) have been introduced in the House of Representatives during the present congressional session calling for accelerated depreciation of capital equipment. Proposals were identical, or nearly so, as congressmen hastened to identify themselves with a movement believed to be popular with their voters.

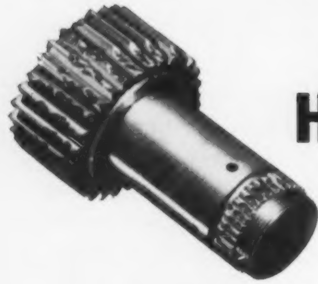
Legislation for a reasonable depreciation would probably have been enacted if the Administration had not been opposed to changes in the tax structure at this time. Fiscal considerations seemed to make the time inopportune so far as the Government was concerned. But Federal tax reform is not dead, and in the opinion of astute economists is absolutely necessary if our country is to maintain its high position among the industrial nations of the world. The issue is certain to come up again during the next Congress.

Liberalization of the tax depreciation policy is necessary to offset the deficiency of present historical-cost allowances and also to speed up the growth of our economy. The deterrent to paying for modern equipment from present-day profits has resulted in the continued use of overage, obsolete machinery in thousands of shops.

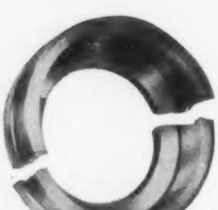
If industrial America is to constantly increase its productivity to keep pace with the growing population and is to remain a bulwark in our line of national defense, its shops must be permitted to keep in tune with the times, equipment-wise. The United States is the greatest industrial nation in the world and yet our depreciation tax laws are considerably less liberal than those of any other industrial country!

Charles O. Herb
EDITOR





How to avoid alloy steel failures



Ordinary precautions may protect you most of the time. But your luck could run out—and a single alloy steel failure can result in serious loss.

That's why the *extra* precautions of the Ryerson Certified Alloy Steel Plan are important to you. Under this plan you know three vital facts about the alloy steel you order from Ryerson stock:

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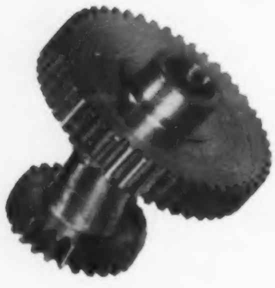

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ROCKET-ENGINE MANUFACTURE

Requires Machining Ingenuity

Uniqueness of component design and the high-temperature-resisting metals from which missile parts are made presented problems solved by the Aerojet-General Corporation with talented personnel and $5,000,000 worth of modern machines.

CHARLES O. HERB, Editor
in collaboration with
W. EDWARD MOLLER, Superintendent, Machine Shop
Liquid Rocket Plant Manufacturing Division
Aerojet-General Corporation, Sacramento, Calif.

OVER ONE MILLION liquid- and solid-propellant rockets have been produced by the Aerojet-General Corporation during the last four years. This fact should be most gratifying to the American public as it proves that our nation has been diligently preparing itself to meet any challenge from a foreign nation. Power plants, boosters, and other components are being supplied by the company mentioned for use on most of our country's missiles.

Products of this concern must operate satisfactorily in space flight and at the extremely high and low temperatures encountered in such flights. Engines and components for missiles must withstand enormous internal pressures and also the action of highly corrosive liquids and gases.

Components and welded assemblies must be machined to exceptionally close tolerances to meet the exacting demands that will be placed on them when they are hurled into space. Coupled with this machine shop problem has been the necessity of devising methods of machining parts of unusual contours and complexities. For example, 4000 holes of small diameter must be drilled in one part to extremely accurate center-to-center distances.

Many of the components are made of high-strength, high-heat-resisting metals which of themselves have presented machining difficulties. All of this calls for capable production personnel and the use of modern machine tools designed for power and accuracy.

This article will describe typical operations in the machine shop of the Air Force-built liquid-rocket manufacturing plant at the Sacramento, Calif., facilities of the Aerojet-General Corporation. This plant operates twenty-four hours a day, six days a week. Many interesting operations cannot be divulged because of security regulations; however, those illustrated will suffice to indicate the high caliber of work performed in rocket-engine manufacture.

The heading illustration shows a Monarch Dyna-Shift engine lathe having a swing of 48 inches over the ways and 36 inches over the cross-slide. It is capable of handling parts up to 63 inches long between centers. This machine is employed for a wide variety of work, including turning and facing of the front and back of injector heads with their many configurations and contours. One side of the injector head is concave and the other, convex in general outline. The injector heads are over 2 feet in diameter. Machining of injector heads is customarily broken into two steps—a roughing operation before heat-treatment, and a finishing operation after heat-treatment.

The injector heads are 17-7 precipitation-hardened stainless-steel forgings. When finished, many surfaces of the injector heads must be to specified dimensions within plus or minus 0.0025 inch. In addition to the finishing of the various surfaces, a series of twenty or more annular grooves must be cut into the concave side of some injector heads. These grooves are square on top and have rounded roots. They are from 0.250 to 0.400 inch wide and from 0.250 to 0.400 inch deep. Size must be maintained within plus or minus 0.005 inch, and the diameters are held within plus or minus 0.005 inch. The lands between the grooves are generally about 0.04 inch wide.

The heading illustration shows this lathe engaged in contour-turning an aluminum nozzle that is about 15 inches in maximum diameter. The path of the cutter is controlled by the operation of the stylus on an air-gage tracer at the rear of the machine. The tracer is mounted on a bar that extends backward from the tool-slide, as seen in Fig. 1. The stylus moves along a template which is converse in shape to the contour of the work. Dimensions of this part are held to size within plus or minus 0.003 inch. The air-gage tracer enables changes in work setups to be effected within a few minutes. It also insures a smooth, stepless finish on the work, and permits the machining of practically any diameters, tapers, bevels, grooves, undercuts, shoulders, and necks in a single continuous cut.

Another feature of this lathe which adapts it to the handling of parts made of various materials is the Dyna-Shift drive to the headstock. Correct spindle speeds for any job can be determined within seconds without the necessity for the operator to make any calculations. He sets the indicator to the desired surface speed and then sets another indicator to the diameter

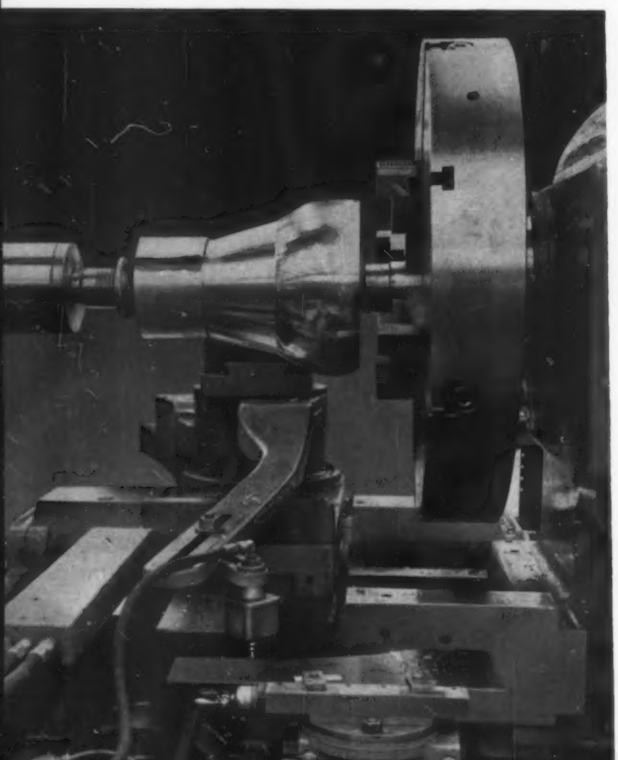


Fig. 1. Turning a rocket nozzle accurately to the required contour on an engine lathe that is also employed for a wide variety of complex work.

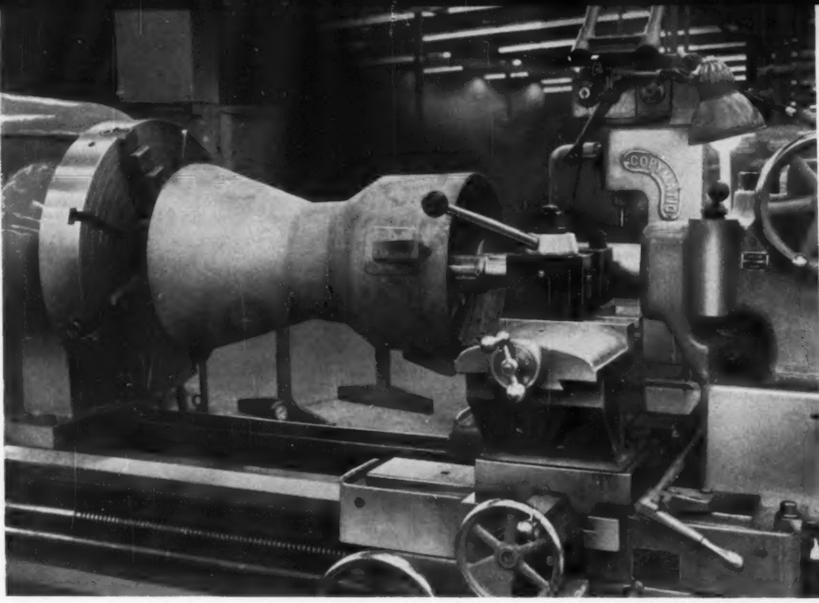


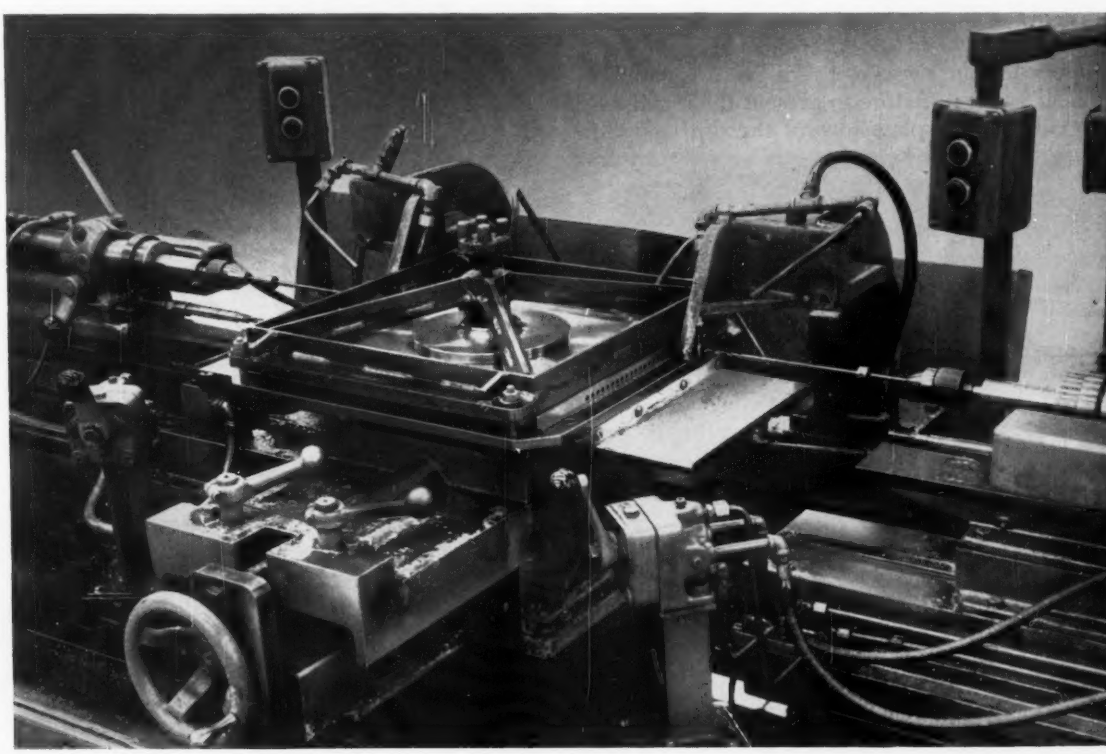
Fig. 2. Machining the large-diameter bore of a case assembly on another engine lathe, with the overhanging end supported by an expanding arbor on the tailstock spindle.

of the work. The correct speed for the cut is then obtained automatically and is shown on an indicator for reference purposes.

The bore of a case assembly is being machined on the Lodge & Shipley lathe shown in Fig. 2, within limits of 16.625 and 16.635 inches. The over-all length of this weldment, which is made of 17-7 precipitation-hardened stainless steel, is approximately 30 1/2 inches. The boring cuts are taken for a length of 4 inches. Support for the overhanging end of the work is provided by an expanding arbor mounted on the tailstock spindle.

An ingenious step-drilling operation on an injector plate is performed by the special Leland-Gifford machine shown in Fig. 3. This part is also made of 17-7 precipitation-hardened stainless steel, and is approximately 20 inches square.

Fig. 3. Twenty-five holes of small diameter must be drilled from all four sides of injector plates, with the opposed holes lining up within 0.005 inch at a depth of 9 inches.



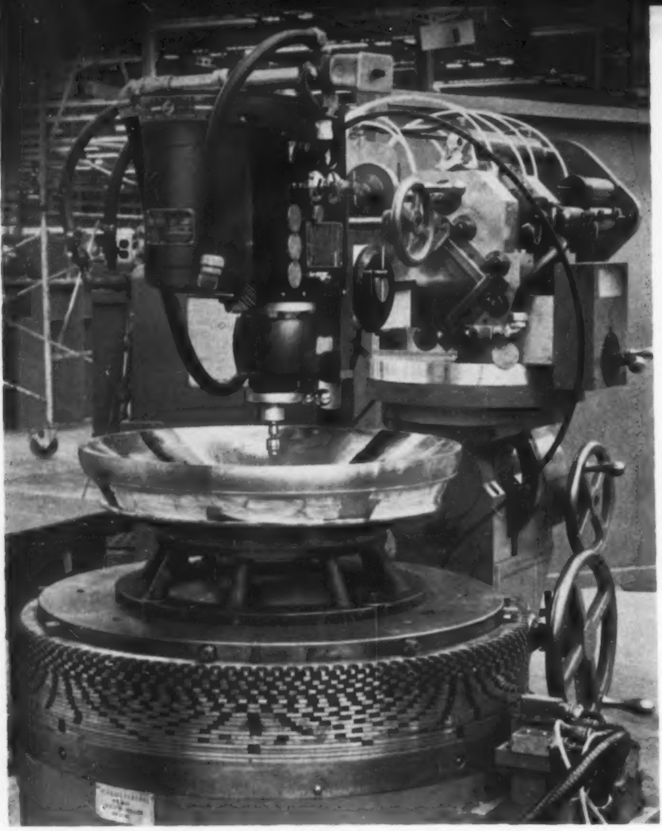


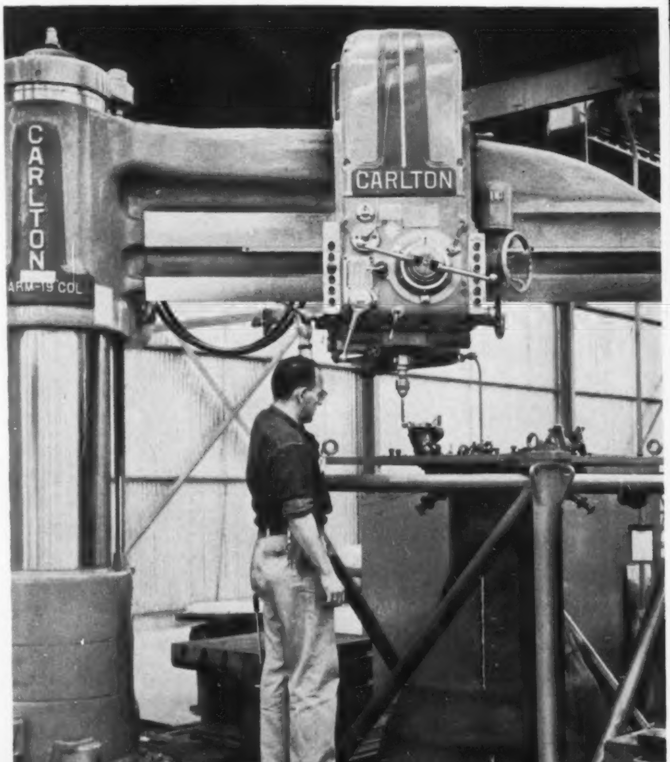
Fig. 4. (Left) Four thousand holes of small diameter must be drilled to accurate center-to-center distances on injector heads by this special machine which is provided with a unique indexing arrangement.

Fig. 5. (Below) The height of assembled missile units necessitates the use of a tall radial drilling machine for final drilling operations. A pit at one side of the machine accommodates higher work.

Twenty-five holes 0.250 inch in diameter must be drilled from all four sides until they meet in the center of the plate. One hole is drilled at a time to a given depth in the part by the two opposing drill spindles, the greatest depth being approximately 9 inches. After the holes have been produced from two sides, the plate is indexed 90 degrees on its fixture to present the remaining two sides of the plate toward the drill spindles for drilling similar holes from those sides to form internal propellant passages. These passages must intersect within 0.005 inch.

Movement of the fixture from back to front to position the work for drilling the successive holes is effected by operating a handle at the front of the cross-slide. Movement of the handle actuates a plunger into and out of a series of locating grooves that are provided in a bar which extends the width of the work fixture. The drill heads are operated hydraulically, moving in and out intermittently to effect the step drilling.

Four thousand holes 0.072 inch in diameter are drilled in the surface of some injector heads by the special machine in Fig. 4, which is equipped with a Dumore automatic drill unit. Spacing of the holes around their center circles is controlled electronically. Accurate indexing is assured by engaging a dog (mounted on a slide seen at the right) between the teeth of the sprocket-like, circular indexing plates that are provided on the table of the machine. Location



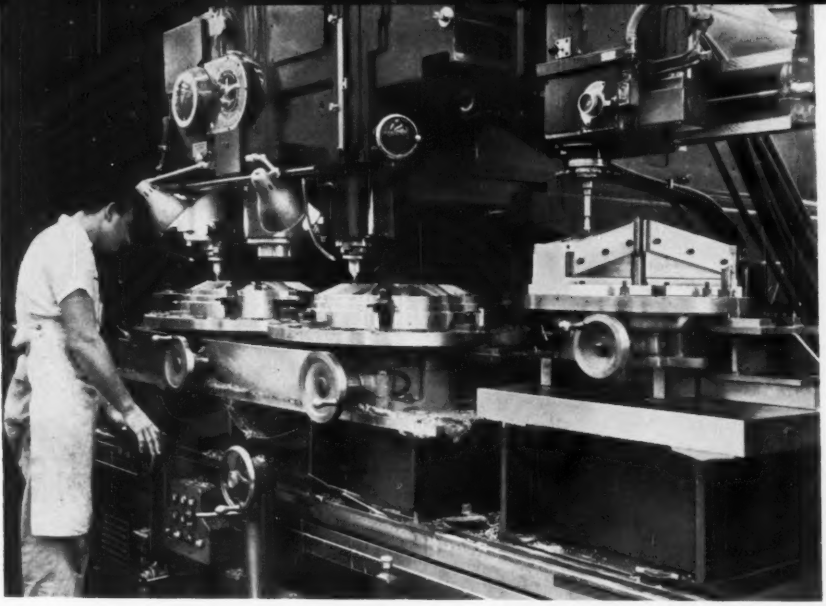


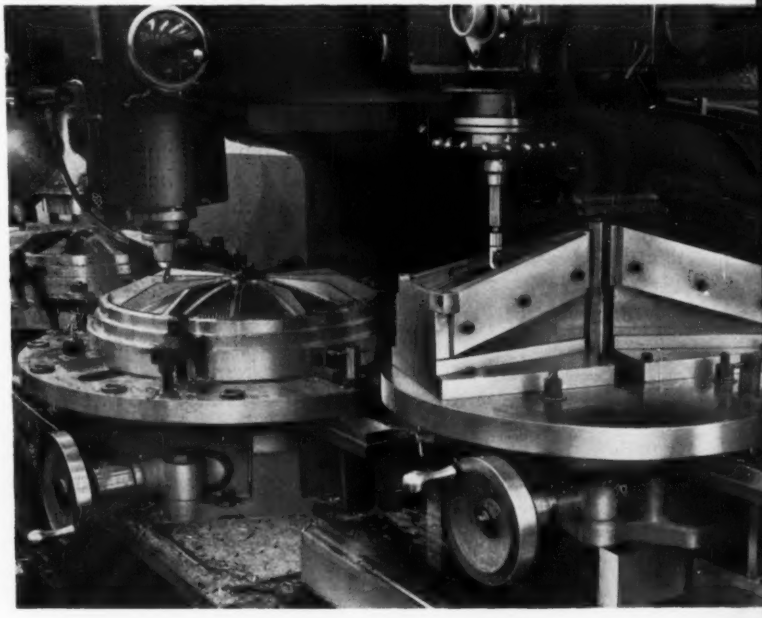
Fig. 6. Hydro-Tel milling machine engaged in simultaneously machining twelve propellant cavities on the convex side of two injector plates.

of the hole-center circles is readily obtained by sliding the drill-head unit back and forth in relation to the center of the work. For this purpose the drill-head unit is mounted on a square arbor that slides in ways provided on the machine unit at the rear. Proper positions of the drill-head unit are obtained by engaging a plunger with detents in a horizontal bar that slides with the drill head. The plunger is, of course, in a fixed location. It takes about thirty hours to drill the 4000 holes.

Sometimes the job assigned to the big Carlton radial drilling machine in Fig. 5 seems a little incongruous, as in the case of the operation illustrated. Here, small holes are being drilled around the flange of a fuel fitting assembled to the injector end of a large thrust chamber. The part could not be drilled until after the thrust chamber had been assembled. Because of the height of the unit, the operation had to be performed by a radial drilling machine having a high column.

It will be seen that the thrust chamber is mounted in a structural fixture which permits convenient transfer about the shop. A pit has been provided at one side of the radial drilling machine to enable the handling of work that is higher than the distance from the floor or table to the underside of the drill head, when the latter is at its maximum height. In the operation shown, the drill was automatically fed through the flange in conventional manner. However,

Fig. 7. Close-up view of the operation in Fig. 6, which clearly shows the arrangement of the two templates required for each injector head.



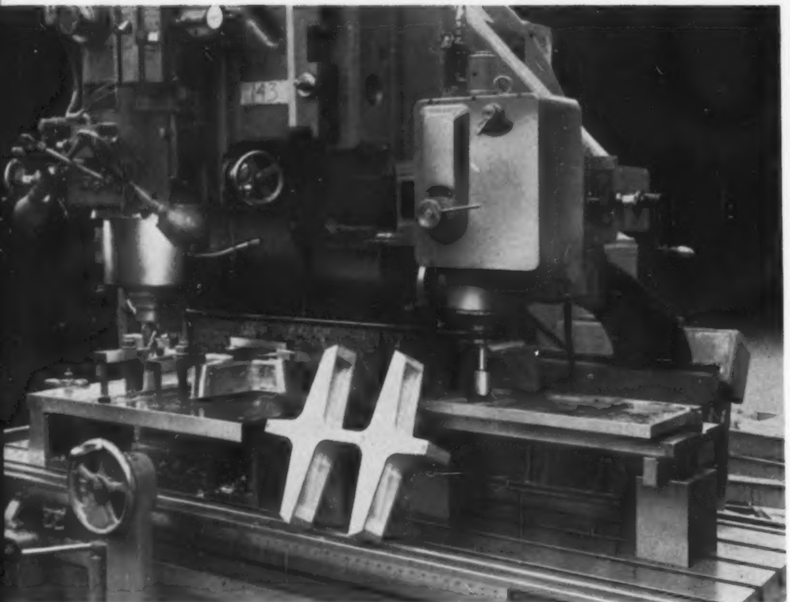


Fig. 8. Typical operation on another Hydro-Tel milling machine which consists of producing a spider gimbal from a solid block of aluminum.

special care must be taken to insure close accuracy in drilling twenty-four holes around the central portion of the engine face to a depth on which a close tolerance is specified. In that operation the spindle is automatically fed to 1/32 inch of the required depth, after which a special hand feed is engaged for the final drilling. The depth of the holes is held to a tolerance as close as 0.001 inch.

Radial location of the twenty-four holes around a base circle of 15.50 inches is also held within close limits. To obtain the required accuracy, use is made of a master drill jig that is coordinated to a hole pattern on the injector head. Hole centers must be true within 0.0005 inch.

The huge Cincinnati Hydro-Tel milling machine in Fig. 6 is also employed for a considerable variety of work. In the operation shown only two of the three milling spindles could be used because of the large diameter of the work. Injector heads of 17-7 precipitation-hardened stainless steel are seen being machined on the back to form the inner propellant-manifold feeding cavities. There are twelve cavities on each head of this particular design.

The cutters are guided by a stylus being fed over the two templates seen at the right in Fig. 7. Two templates are required because there are two different cavities around the injector head, one set of cavities having a step along a wall. When one series of cavities has been milled, the circular table on which the templates are mounted is indexed 180 degrees to bring the second template beneath the stylus. Then, the second series is milled. Cuts are taken to depths as great as 1 1/2 inches, and to a tolerance of plus or minus 0.005 inch. These cavities are later finished to a high degree of smoothness by hand lapping.

Another Cincinnati Hydro-Tel milling machine used for a wide variety of work is illustrated in Fig. 8, engaged in machining a spider gimbal for the gimbal assembly. The part is produced from a solid aluminum billet, being first rough-cut to the approximate outline on a DoALL band-sawing machine. Pockets are then milled in the legs of the gimbal on a setup on the Hydro-Tel machine. Finally, the complete profile is milled accurately to the required outline in the setup shown. It will be seen that the template for this job has three openings.

° ° °

New Technique in Precision Casting of Aluminum

A novel technique in plaster-mold casting has been developed by the Precision Casting Division of Airtron, Inc., Linden, N. J. The cores are prepared in separate sections, and then accurately bolted together with hidden studs and nuts. This sectional process affords greater control of internal dimensions, thereby insuring more accuracy for precision-cast components. This technique is especially beneficial when used for the manufacture of waveguides or other large units requiring precise dimensional tolerances and good surface finish.

Gear Calculations Simplified by Use of Williamson Tables

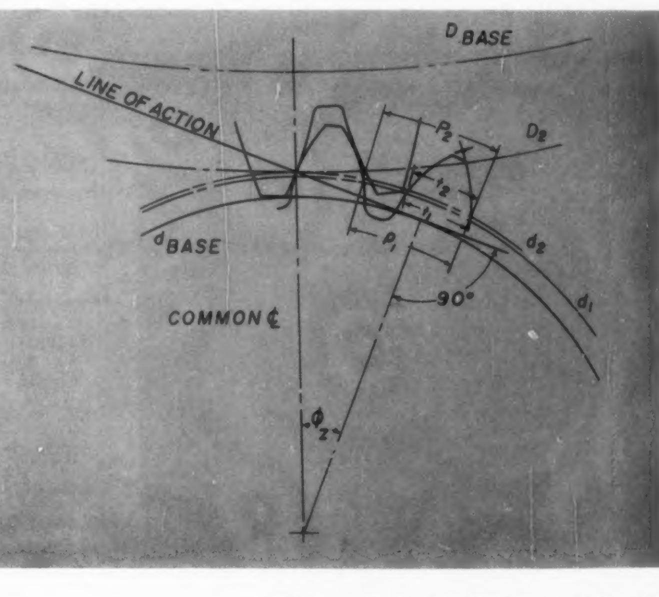
CLARENCE A. UNDERWOOD, Gear Consultant
Raytheon Mfg. Co., Wayland, Mass.

COMPUTATION of the size of involute gear-tooth elements for gears which depart from basic or original specifications is usually lengthy and cumbersome. Such calculations, however, can be simplified by the use of tables recently compiled by J. L. Williamson of the Fellows Gear Shaper Co., Springfield, Vt. These tables, which appeared in part in September, 1957, MACHINERY, obviate the use of any other tables and reduce the necessary number of steps in the calculations.

The Williamson tables are convenient for such applications as obtaining the effective tooth thickness at various diameters, finding the center distance for gears of known arc tooth thicknesses, computing dimensions over or between precision gear measuring pins, and solving for a new center distance (or ratio) where a change in the original ratio (or center distance) is desired.

Involute gears make contact on a locus which is a straight line tangent to the generating or base circles. When two gears are in mesh, the line tangent to the base circles of both gears crosses the common center line and is called the line of action, as indicated in the accompanying illustration. The distance to the crossing point (pitch point) measured from the center of each gear is its pitch radius. If the distance between the centers of the gears changes, the angle of the line of action also changes, and a new pitch point and pitch radii are created. The ratio of the second center distance to the first is equal to the inverse ratio of the cosines of the angles of action. This ratio may be called the "cosine ratio," and when it is used in combination with the differences in involute functions of the respective angles, the computation of gear element sizes and over-the-pin measurements is reduced.

The original Williamson tables are a listing of involute function differences and the corresponding cosine ratios for various base pressure angles. They were compiled as an aid in determining the center distance to be used between part gears and a known master gear when measuring the effective size of production gears. The following examples illustrate the many additional applications of the tables. Portions of the Williamson tables pertaining to gears with 20- and 30-degree base pressure angles are given in the accompanying table. As an added feature, the differences between tabulated values are listed for convenience when interpolating.



The "line of action "of involute gears is a straight line tangent to the base circles of both gears, crossing their common center line at the pitch point. Basic tooth elements are indicated by symbol. Subscripts 1 and 2 indicate the original and new tooth-element dimensions, respectively.

To minimize the use of subscripts in the equations, lower-case letters indicate pinion elements and upper-case letters indicate gear elements. With a few exceptions, letter symbols (defined in the accompanying list) agree with the AGMA Standard 111.03. Original formulas, unless otherwise indicated, are from the *Manual of Gear Design* by Earle Buckingham, published by The Industrial Press.

From fundamental equations of involute gearing, Mr. Williamson developed the relationship

$$I = \frac{t + T - p}{2C} \qquad (1)$$

which he used to evaluate (from given arc tooth thicknesses) the numerical difference between the involute functions of the specified pressure angle and the active pressure angle resulting from a change in the center distance of mating gears. The involute function difference I is then correlated by means of a table to a ratio between the cosines of the active and design pressure angles (cosine ratio). When this cosine ratio is known, not only the new center distance, but new meshing or pitch diameters, new circular pitch, and active pressure angles can also be determined. These calculations are accomplished without having to refer to tables of trigonometry, or of involute functions.

The following derivations illustrate the method used to eliminate cosine and involute functions from involute gear equations:

$$r_2 \cos \phi_2 = r_1 \cos \phi_1$$

and

$$d_2 \cos \phi_2 = d_1 \cos \phi_1$$

thus

$$\frac{d_2}{d_1} = \frac{\cos \phi_1}{\cos \phi_2} = \text{cosine ratio} \qquad (2)$$

also

$$\text{cosine ratio} = \frac{C_2}{C_1} \qquad (3)$$

Letter Symbol Definitions

ϕ ϕ_1 ϕ_2	Pressure angle
t	Arc tooth thickness, pinion
T	Arc tooth thickness, gear
p	Circular pitch
P	Diametral pitch
r r_1 r_2	Pitch radii
d_1 d_2	Pitch diameters
d	Measuring pin diameter
n	Number of teeth, pinion
N	Number of teeth, gear
C	Center distance
D_M	Pin dimension
I	Involute function difference
Δ	A change

Sometimes arc tooth thicknesses at more than one diameter of the gear are required. The equation used for this purpose is derived as follows:

$$t_2 = d_2 \left(\frac{t_1}{d_1} + \text{inv } \phi_1 - \text{inv } \phi_2 \right)$$

where

d_1 = first diameter;
d_2 = second diameter;
ϕ_1 = pressure angle at d_1;
ϕ_2 = pressure angle at d_2;
t_1 = arc tooth thickness at d_1;
t_2 = arc tooth thickness at d_2.

Simplifying

$$t_2 = \left(\frac{d_2}{d_1} \times t_1 \right) + d_2 (\text{inv } \phi_1 - \text{inv } \phi_2)$$

but $I = \text{inv } \phi_1 - \text{inv } \phi_2$ and $\frac{d_2}{d_1} = \text{cosine ratio}$

therefore

$$t_2 = (\text{cosine ratio} \times t_1) + (d_2 \times I) \qquad (4)$$

and

$$t_1 = \frac{t_2 - (d_2 \times I)}{\text{cosine ratio}} \qquad (5)$$

In using the tables the sign of the involute function difference becomes plus or minus, depending on whether the active pressure angle is greater or less than the original design pressure angle.

If d_2 is not required and the cosine ratio or I is known, Equation (2) permits Equation (4) to be rewritten as:

$$t_2 = (\text{cosine ratio} \times t_1) + (d_1 \times \text{cosine ratio} \times I)$$

or

$$t_2 = \text{cosine ratio } [t_1 + (d_1 \times I)] \qquad (6)$$

and similarly Equation (5) becomes

$$t_1 = \frac{t_2}{\text{cosine ratio}} - (d_1 \times I) \qquad (7)$$

Another convenient usage of the tables is in determining the circular pitch at a second diameter:

As

$$p_2 = p_1 \frac{d_2}{d_1}$$

therefore

$$p_2 = p_1 \text{ cosine ratio} \qquad (8)$$

Solving for measurements over or between pins is a brief calculation:

$$I = \frac{1}{D} \left(\frac{d}{\cos \phi} - S \right) \text{ from AGMA Standard 231.51} \qquad (9)$$

where

D = reference diameter for known arc tooth thickness;
d = pin diameter;
ϕ = pressure angle at D;
S = arc tooth space (circular pitch less arc tooth thickness).

$$I = \frac{1.838899 - S}{N}$$

for standard 1.728-series measuring pin for $1P$ and 20-degree pressure angle, and

Involute Function Difference and Cosine Ratio for Gears with 20-Degree and 30-Degree Base Pressure Angles ϕ_1 at Various Active Pressure Angles ϕ_2

Active Pressure Angle ϕ_2 in Degrees	Involute Function Difference (I)	Tabular Difference	Cosine Ratio	Tabular Difference
FOR GEARS WITH A 20-DEGREE BASE PRESSURE ANGLE				
20	0		1.0	
20.1	0.00023247		1.0006371	
		0.00023500		0.0006411
20.2	0.00046747		1.0012782	
		0.00023744		0.0006449
20.3	0.00070491		1.0019231	
		0.00024021		0.0006488
20.4	0.00094512		1.0025719	
		0.00024268		0.0006527
20.5	0.00118780		1.0032246	
		0.00024528		0.0006566
20.6	0.00143308		1.0038812	
		0.00024790		0.0006605
20.7	0.00168098		1.0045417	
		0.00025052		0.0006645
20.8	0.00193150		1.0052062	
		0.00025317		0.0006684
20.9	0.00218467		1.0058746	
		0.00025584		0.0006724
21	0.00244051		1.0065470	
		0.00025852		0.0006763
21.1	0.00269903		1.0072233	
		0.00026123		0.0006804
21.2	0.00296026		1.0079037	
		0.00026394		0.0006853
21.3	0.00322420		1.0085880	
		0.00026667		0.0006883
21.4	0.00349087		1.0092763	
		0.00026944		0.0006923
21.5	0.00376031		1.0099686	
		0.00027220		0.0006964
21.6	0.00403251		1.0106650	
		0.00027499		0.0007004
21.7	0.00430750		1.0113654	
		0.00027781		0.0007045
21.8	0.00458531		1.0120699	
		0.00028063		0.0007086
21.9	0.00486594		1.0127785	
		0.00028347		0.0006133
22	0.00514941		1.0133818	
		0.00028634		0.0008260
22.1	0.00543575		1.0142078	
		0.00028922		0.0007208
22.2	0.00572497		1.0149286	
		0.00029212		0.0007250
22.3	0.00601709		1.0156536	
		0.00029503		0.0007291
22.4	0.00631212		1.0163827	
		0.00029798		0.0007332
22.5	0.00661010		1.0171159	
		0.00030093		0.0007374
22.6	0.00691103		1.0178533	
		0.00029391		0.0007416
22.7	0.00720494		1.0185949	
		0.00031690		0.0007557
22.8	0.00752184		1.0193406	
		0.00030992		0.0007500
22.9	0.00783176		1.0200906	
		0.00031295		0.0007542
23	0.00814471		1.0208448	
		0.00031600		0.0007584
23.1	0.00846071		1.0216032	
		0.00031907		0.0007626
23.2	0.00877978		1.0223658	
		0.00032216		0.0007670
23.3	0.00910194		1.0231328	
		0.00032528		0.0007711
23.4	0.00942722		1.0239039	
		0.00032840		0.0007755
23.5	0.00975562		1.0246794	
		0.00033155		0.0007798
23.6	0.01008717		1.0254592	
		0.00033473		0.0007841
23.7	0.01042190		1.0262433	
		0.00033791		0.0007884
23.8	0.01075981		1.0270317	
		0.00034112		0.0007928
23.9	0.01110093		1.0278245	
		0.00034435		0.0007971
24	0.01144528		1.0286216	
		0.00034761		0.0008015
24.1	0.01179289		1.0294231	
		0.00035087		0.0008059
24.2	0.01214376		1.0302290	
		0.00035416		0.0008103
24.3	0.01249792		1.0310393	
		0.00035748		0.0008147
24.4	0.01285540		1.0318540	
		0.00036081		0.0008192
24.5	0.01321621		1.0326732	
		0.00026416		0.0008236
24.6	0.01358037		1.0334968	
		0.00036754		0.0008280
24.7	0.01394791		1.0343248	
		0.00037093		0.0008326
24.8	0.01431884		1.0351574	
		0.00037434		0.0008371
24.9	0.01469318		1.0359945	
		0.00037779		0.0008415
25	0.01507097		1.0368360	
		0.00397163		0.0086678
26	0.01904260		1.0455038	
		0.00433957		0.0091378
27	0.02338217		1.0546416	
		0.00473069		0.0096261
28	0.02811286		1.0642677	
		0.00514633		0.0101336
29	0.03325919		1.0744013	
		0.00558792		0.0106622
30	0.03884711		1.0850035	
		0.00605706		0.0112132
31	0.04490417		1.0962767	
		0.00655544		0.0117885
32	0.05145961		1.1080652	
		0.00708495		0.0123897
33	0.05854456		1.1204549	
		0.00764763		0.0130192
34	0.06619219		1.1334741	
		0.00824573		0.0136787
35	0.07443792		1.1471528	
		0.00888170		0.0143711
36	0.08331962		1.1615239	
		0.00955820		0.0150987
37	0.09287782		1.1766226	
		0.01027830		0.0158644
38	0.10315612		1.1924870	
FOR GEARS WITH A 30-DEGREE BASE PRESSURE ANGLE				
30	0		1.0	
31	0.00605706		1.0103341	
		0.00655544		0.0108643
32	0.01261250		1.0211984	
		0.00708495		0.0114184
33	0.01969745		1.0326168	
		0.00764763		0.0119985
34	0.02734508		1.0446153	
		0.00824573		0.0126065
35	0.03559081		1.0572218	
		0.00888170		0.0132444
36	0.04447251		1.0704662	
		0.00955820		0.0139150
37	0.05403071		1.0843812	
		0.01027830		0.0146208
38	0.06430901		1.0990020	
		0.01104510		0.0153644
39	0.07535410		1.1143664	
		0.01186230		0.0161494
40	0.08721640		1.1305158	
		0.01273380		0.0169791
41	0.09995020		1.1474949	
		0.01366410		0.0178572
42	0.11361430		1.1653521	
		0.01465771		0.0187882
43	0.12827201		1.1841403	
		0.01572040		0.0197766
44	0.14399241		1.2039169	

$$I = \frac{2.043221 - S}{N}$$

for enlarged pinion 1.92-series measuring pin for 1*P* and 20-degree pressure angle.

After solving for *I*, the corresponding cosine ratio, cosine ratio$_{pin}$, can be obtained from the table, and the required pin measurements are calculated from the equations

$$D_M = (D \times \text{cosine ratio}_{pin}) \pm d \qquad (10)$$

(for gears with an even number of teeth) and

$$D_M = \left(D \times \cos\frac{90}{N}\text{ degrees} \times \text{cosine ratio}_{pin}\right) \pm d \qquad (11)$$

(for gears with an odd number of teeth).

For example, consider a case where the gear ratio is changed but the center distance established by the original gears is maintained in order to use the same housing. This results in a "non-standard" center distance—one which does not equal one-half the sum of the teeth in the gears used divided by the diametral pitch. (The following examples are solved for gears of 1 diametral pitch. For other pitch gears the results are divided by the diametral pitch.)

If the new gear ratio $\frac{N}{n} = \frac{154}{79}$, then C_1, the "standard" center distance, $= \frac{79 + 154}{2} = 116.5$ inches.

In addition, other known values are:
C_2, center distance for housing, $= 119$ inches;
d_1, meshing diameter of first gear at C_1, $= 79$ inches;
ϕ_1, pressure angle at d_1, $= 20$ degrees.

Solving for t_1, the arc tooth thickness of first gear at ϕ_1,

$$t_1 = \frac{\pi}{2} = 1.570796 \text{ inches}$$

The arc tooth thickness and the dimension over pins for a tight mesh can be determined as follows when the enlargement necessary for the increased center distance is accomplished in the pinion:

$$\text{cosine ratio} = \frac{119}{116.5} = 1.0214592 \quad \text{(from Eq.3)}$$

$$\begin{aligned}
&= -0.00840063 \quad \text{(from table)}\\
d_2 &= 79 \times 1.0214592 \quad \text{(from Equation 2)}\\
&= 80.6952768 \text{ inches}\\
\Delta t_1 &= (d_2 - d_1)\tan\phi\\
&= (80.6952768 - 79)\tan 20 \text{ degrees}\\
&= 0.617033 \text{ inches}
\end{aligned}$$

This is the amount of displacement required on one side of an involute gear tooth to fill the space created by the increased distance between centers.

The new arc tooth thickness is:

$t_1 = 1.570796 + 0.617033 = 2.187829$ inches
using Equation (4)
$t_2 = [1.021459 \times 2.187829] + [80.695277 \times (-0.00840063)]$
$t_2 = 1.556886$ inches

This is the arc tooth thickness at the actual meshing diameter d_2. The thickness of the tooth tip may be found in the same manner.

Often knowledge of the diameter at which the tooth comes to a point (where the involutes of a tooth intersect) is desired. This diameter can be obtained as follows:

$$\text{inv}\,\phi_3 = \frac{t_1}{d_1} + \text{inv}\,\phi_1 \quad \text{and} \quad d_3 = d_1\frac{\cos\phi_1}{\cos\phi_3}$$

$$\frac{t_1}{d_1} = \text{inv}\,\phi_3 - \text{inv}\,\phi_1$$

In this article Δ inv $= I$. Therefore

$$I = \frac{t_1}{d_1} = 0.02769403 \qquad (12)$$

and, from the table,

$$\text{cosine ratio} = 1.0634158$$
$$d_3 = d_1 \text{ cosine ratio} = 84.009848 \text{ inches} \qquad (13)$$

In solving for the measurement over pins, additional data are:

$$d = 1.92 \text{ inches}$$
$$S = \pi - t_1 = 0.9537636 \text{ inches}$$

Using Equation (9)

$$I = \frac{1}{79} \times \left(\frac{1.92}{0.9396926} - 0.9537636\right) = 0.01379060$$

and

$$\text{cosine ratio}_{pin} = 1.0339704 \text{ (from table)}$$

Then from Equation (11)

$D_M = 79 \times 0.99980235 \times 1.0339704 + 1.92$

$D_M = 83.587517$ inches

For a 96-pitch gear $D_M = 0.8707$ inch

To find the center distance for no backlash with gears of known proportions, Formula (1) is used. As an example, consider 18- and 174-tooth gears with:

$\phi = 20$ degrees;
t_1 (enlarged) $= 1.7528$ inches;
T_1 (reduced) $= 1.542$ inches.

Then

$$C_1 = \frac{18 + 174}{2} = 96 \text{ inches}$$

and

$$I = \frac{1.7528 + 1.542 - \pi}{2 \times 96} \qquad (1)$$

$$I = 0.000797955$$

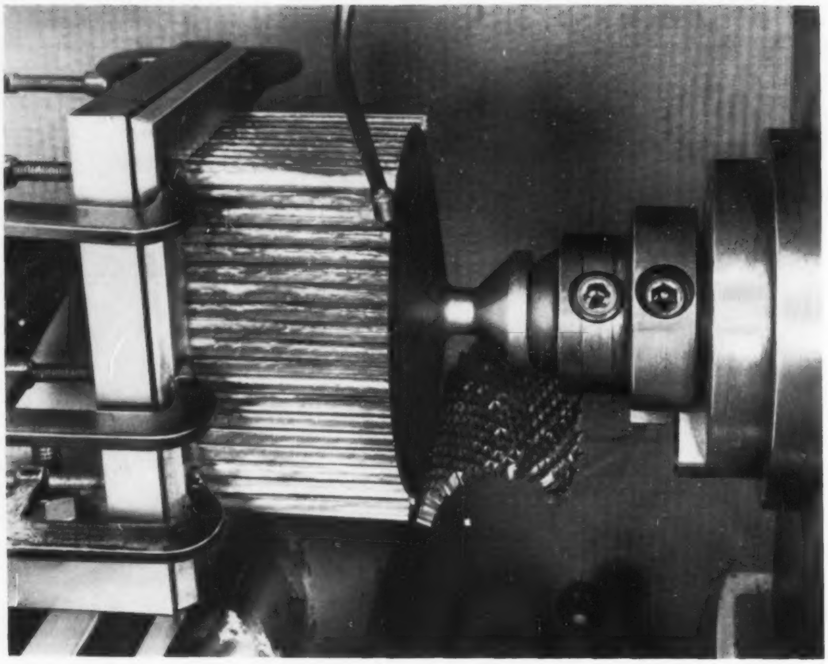
From the table cosine ratio $= 1.0021725$ and

$C_2 = 96 \times 1.0021725 = 96.20856$ inches.

For a 3-pitch gear $C_2 = 32.06952$ inches.

Formulas for Applying Williamson Tables to Gear Calculations

To Find	Given	Equations Required	Equation Number
Involute Function Difference (I)	$t\ T\ p\ C$	$I = \frac{t + T - p}{2C}$	1
Center Distance (C_2)	$t_1\ T_1\ p_1\ C_1$	$I = \frac{t_1 + T_1 - p_1}{2C_1}$	1
		$C_2 = C_1 \times$ cosine ratio (obtain cosine ratio from table)	3
Tooth Thickness (t_2)	$t_1\ d_1\ d_2$	cosine ratio $= \frac{d_2}{d_1}$	2
		$t_2 =$ (cosine ratio $\times\ t_1) + (d_2 \times I)$ (obtain I from table)	4
(t_2)	$t_1\ d_1\ C_1\ C_2$	cosine ratio $= \frac{C_2}{C_1}$	2
		$t_2 =$ cosine ratio $[t_1 + (d_1 \times I)]$	6
Circular Pitch (p_2)	$p_1\ d_1\ d_2$	$p_2 = p_1 \frac{d_2}{d_1} = p_1$ cosine ratio	8
Pin Dimensions (D_M)	$S\ d\ D\ \cos\phi$	$I = \frac{1}{D}\left(\frac{d}{\cos\phi} - S\right)$	9
		$\phi =$ any base pressure angle	
		FORMULAS WITH CONSTANTS WHEN $\phi = 20$ DEGREES	
		Standard measuring pin $d = 1.728$ inches for $1P$	
		(a) $I = \frac{1.838899 - S}{N}$ (b) $I = \frac{0.268103}{N}$ (standard proportion gear)	
		(c) $I = \frac{T_1 - 1.3026936}{N}$ (d) $I = \frac{0.268103 + \Delta T_1}{N}$	
		($S = \pi - T_1$ or $S = 0.5\,\pi - \Delta T_1$)	
		Enlarged pinion measuring pin $d = 1.92$ for $1P$	
		(a) $I = \frac{2.043221 - S}{N}$ (b) $I = \frac{T_1 - 1.098372}{N}$ (c) $I = \frac{0.472425 + \Delta T_1}{N}$	
		FORMULAS WITH CONSTANTS WHEN $\phi = 30$ DEGREES	
		Standard measuring pin $d = 1.728$ inches for $1P$	
		(a) $I = \frac{1.9953216 - S}{N}$ (b) $I = \frac{0.4245256}{N}$ (standard proportion gear)	
		(c) $I = \frac{T_1 - 1.1462710}{N}$ (d) $I = \frac{0.4245256 + \Delta T_1}{N}$	
		Enlarged pinion measuring pin $d = 1.92$ inches for $1P$	
		(a) $I = \frac{2.217024 - S}{N}$ (b) $I = \frac{0.6462280}{N}$ (standard proportion gear)	
		(c) $I = \frac{0.6462280 + \Delta T_1}{N}$	
		$D_M = (D \times \text{cosine ratio}) + d$ even teeth, external	10
		$D_M = (D \times \text{cosine ratio}) - d$ even teeth, internal	10
		$D_M = \left(D \times \cos\frac{90}{N}\text{ degrees} \times \text{cosine ratio}\right) + d$ odd teeth, external	11
		$D_M = \left(D \times \cos\frac{90}{N}\text{ degrees} \times \text{cosine ratio}\right) - d$ odd teeth, internal	11
Diameter at which Teeth become Pointed (d_3)	$t_1\ d_1$ at base angle ϕ_b	$I = \frac{t_1}{d_1}$	12
		$d_3 = d_1 \times$ cosine ratio	13



How Easily Can Honeycomb Structures be Machined?

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HONEYCOMB sandwich structures can be considered engineering material fabricated in sheet form, having physical properties particularly desirable in aircraft construction. Ideally, this material would have the following basic characteristics:

1. Could be made in a single manufacturing process to the desired total thickness–having high-strength integral skins and an internal cellular structure somewhat like that of plastic and foam rubber.

2. Outer skin and cellular center structure could be so well controlled that optimum strength (stiffness)-to-weight ratio would always be obtained.

The attractive strength-to-weight ratio of honeycomb sandwich structures is due to the location of the relatively dense, high-strength material in the extreme fibers. Here, in flexure, the unit stress is the greatest: the low-density, weak material is in the core where the unit stress is the least. Any aircraft not being propelled as a projectile is essentially a flying flexural member; hence, the importance of sandwich structures in this field.

To use this material effectively, its composite physical properties must be recognized so that structures may be confidently designed with the knowledge that they can be readily fabricated. The working of honeycomb structures presents many unique problems because the thin (0.010 to 0.025 inch thick), tough skins are not well supported. An analogous problem might be an attempt to drill a 1/2-inch diameter hole through

a piece of 0.010-inch thick steel foil that is backed by a pad of sponge rubber. Or, one might try to machine 0.002-inch thick steel foil by ordinary shop techniques. Consider, also, the task of clamping a piece of sponge rubber to a machine table without crushing it. These are the problems faced when attempting to machine components of honeycomb sandwich structure.

It becomes immediately apparent that auxiliary core support must be provided, and that machining operations must be performed with little or no tool pressure. Any filler to be used as support material for the honeycomb core should meet the following conditions:

1. Be readily obtainable and inexpensive.
2. Be easily applied with little or no special equipment.
3. Be easily removed and re-used.
4. Should provide adequate support to the honeycomb material during required machining operations.

Filler materials were used as a medium for mounting honeycomb cores during tests conducted at the General Electric Co. This was done in a 16-gage, sheet-steel tray measuring approximately 1 inch larger on all sides than the part to be held (heading illustration). The edges of the tray were about 5/16 inch high and bent inward at an angle of 30 degrees from the perpendicular. Clamps were used to secure the tray, containing the mounting filler, (in this case, Cerrobend) and the work to an angle bracket on the machine table.

Machining with Special Cutters

During machining tests of honeycomb material, a number of special cutters were constructed. Nine of these are illustrated in Fig. 1.

Cutters No. 1 and 3 were designed to cut out the facing sheet in the manner of an end-mill. During the test the core collapsed, since it could not resist the pressure necessary for proper functioning of these two cutting tools. Cutters No. 2 and 4 were intended to follow Nos. 1 and 3, respectively, to remove the core of the sandwich structure. Although the knife-like, peripheral cutting edge sliced through the core material as planned, the internal end-mill portion of the cutters failed to remove that part of the facing sheet left by the first two cutters.

Only cutters No. 5 and 6 proved to be practical. Cutter No. 5 is made of 18-4-1 high-speed steel hardened from 58 to 62 Rockwell C. It is a mushroom-shaped tool, 6 inches in diameter, with an included knife-edge angle of 5 degrees and a dish angle also of 5 degrees. Cutter No. 6 is of the same material, 3 inches in diameter, with an included knife-edge angle of 5 degrees and a dish angle of 10 degrees.

Both these cutters performed well at speeds of 2400 and 3200 sfm (surface feet per minute). Feed rates as high as 30 ipm (inches per minute) were used with good tool life. They consistently cut slices as thin as 0.025 inch, leaving the trimmed surface straight and the edges of the cells clean and practically free of burrs, as can be

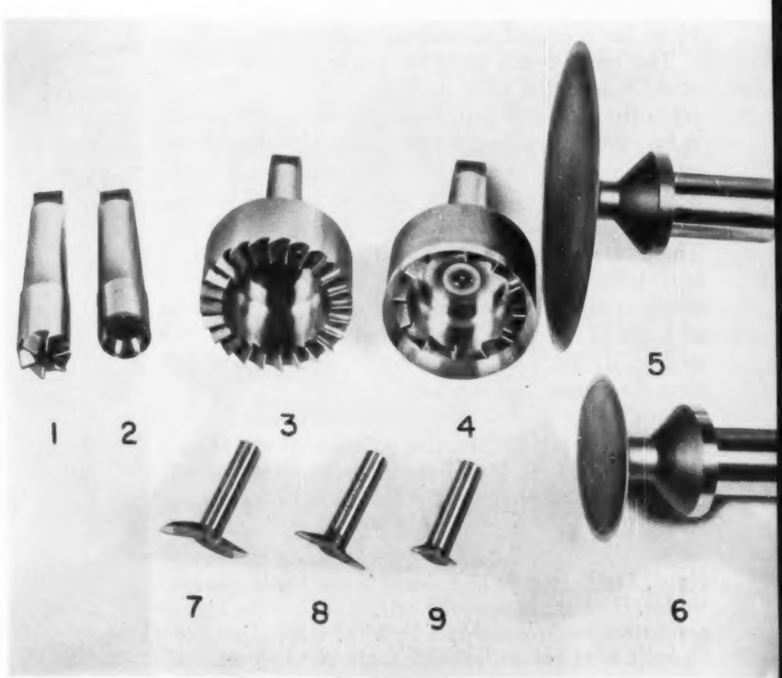


Fig. 1. Nine special cutters that were designed for use on cores. Nos. 1, 2, 3, and 4 are hole cutters; Nos. 5 and 6, core-height trimmers; and Nos. 7, 8, and 9, shoulder-machining cutters. Only Nos. 5 and 6 proved successful.

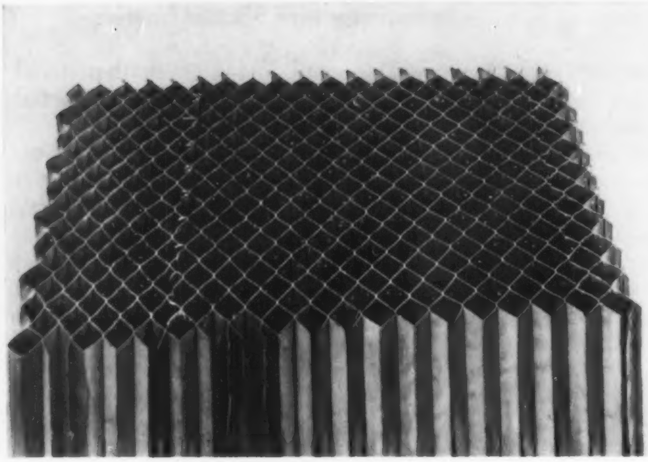


Fig. 2. Fragility of honeycomb cores is clearly seen in this test sample. A slice has been removed from the top surface by trimming knife No. 5 (Fig. 1). The cut edges are straight and almost burr-free.

seen in Fig. 2. The machine setup for this slicing operation is shown in the heading illustration and in Fig. 3.

Three fly type cutters are designated Nos. 7, 8, and 9 in Fig. 1. It was found that they could not be used satisfactorily for cutting recesses or shoulders because, with the exception that the cut is intermittent, they functioned in the same general way as the slicing cutters No. 5 and 6.

Milling Tests on Honeycomb Core Material

Results of tests involving the slicing of core material have been presented in the foregoing paragraphs. This is not the only type of machining that has been studied: milling of honeycomb cores has received considerable attention.

The honeycomb must be made rigid to withstand the action of a milling cutter. To accomplish this, several core sections were filled with different materials to determine the merits of each. One milling operation was performed with a side-milling cutter, 1/4 inch wide by 6 inches in diameter, having thirty-six staggered teeth. The core was filled with a mixture of iron powder and sodium silicate. Climb-milling cuts were made at speeds up to 150 rpm and at feed rates of 1 1/4 to 6 1/8 ipm. Results of this can be seen in Fig. 4. The edges are fairly clean, although some breakout of the filler is evident.

Another core section of the same general configuration was filled with a mixture of stainless-steel powder and sodium silicate. The same cutter was operated at speeds of 130 to 500 rpm, with feed rates varying from 1 1/4 to 16 ipm, and a 1/8-inch depth of cut. All cuts were good: edges of the honeycomb were clean with no breakout of the filler, Fig. 5.

Several other tests were run using different fillers. Among the less successful of these were Shell Chemical Corporation's Epoxy Nos. 1001 and 1004; also Furane Plastics, Inc., Epocast H-883. No combination of speeds and feeds proved satisfactory due to the brittleness of the materials. They consistently broke away from the core metal, causing severe burrs.

While using the same 6-inch diameter, side-milling cutter, Shell's Epoxy No. 1007 was tried.

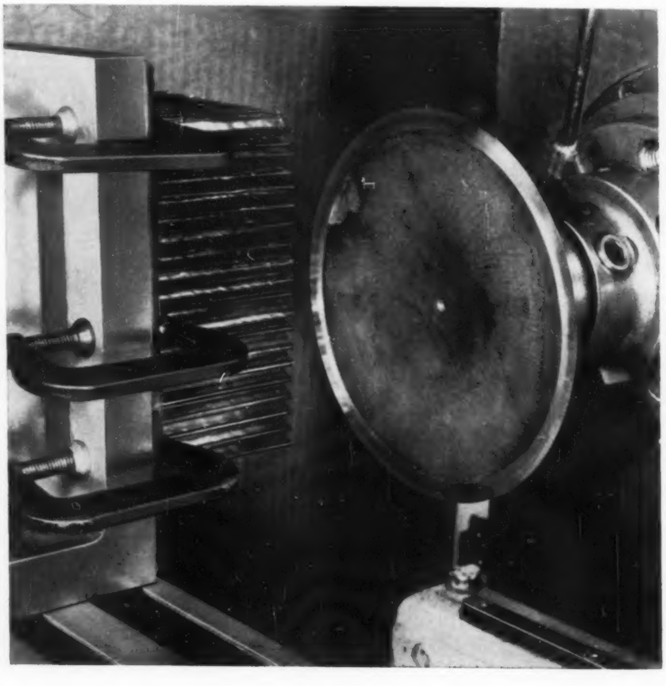


Fig. 3. Same setup as that shown in the heading illustration. Here can be seen the cutting edge of the high-speed steel, mushroom-shaped tool. The 6-inch diameter knife edge has an included angle of 5 degrees.

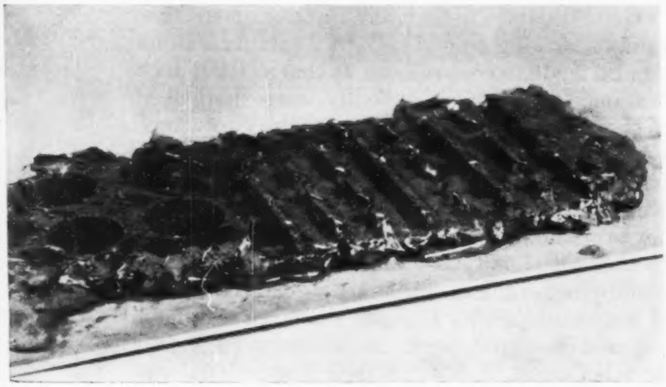


Fig. 4. After filling these core cells with a mixture of iron powder and sodium silicate, cuts were made with a staggered-tooth side mill. Some breakout of the filler is evident.

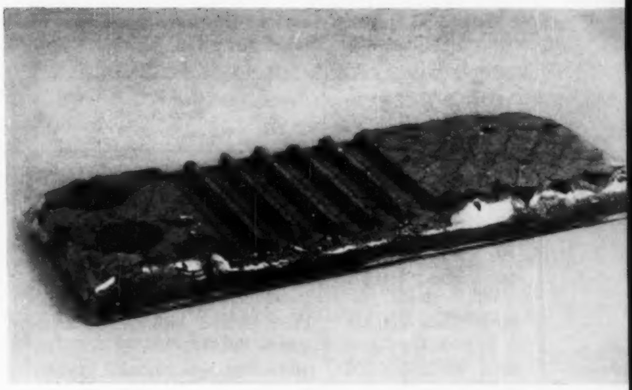


Fig. 5. In this case the filler was stainless-steel powder and sodium silicate. Using the same cutter as in Fig. 4, but with varied speeds and feeds, a noticeably improved cut was obtained.

This material, which has a higher melting point than the others, showed that it could be used from the machining point of view.

A 3/4-inch diameter, four-flute end-mill was used in another series of tests. The fillers used were Shell's Epoxy Nos. 1001, 1004, and 1007; also Furane's Epocast H-883. All were satisfactory. This method of producing slots in honeycomb cores was successful when using a feed rate of 6 1/8 ipm and a speed of 56 rpm.

Producing Holes in Honeycomb Sandwiches

Studies to date indicate that there is only one good way to produce an accurate hole in honeycomb sandwich structures, and that is to grind it. There is not enough support inherent in the work to permit drilling by either conventional or modified means without the use of a filler. Drills with a point angle of 60 degrees, standard and modified center drills, and flat-point (166-degree negative angle) drills have been tried without success.

In each grinding test, a flat sample of honeycomb sandwich was clamped to a faceplate, or held in a chuck, and rotated. A cup type grinding wheel, of a grit appropriate to the material being worked, was rotated at a speed of 16,000 rpm and fed into the sandwich. The center line of the wheel was eccentrically located with respect to the hole center.

It is also possible to produce holes by electrical-discharge machining, although the time required —in excess of fifteen minutes for a 1-inch diameter hole in 1/2-inch thick material—was considered too slow to be practical. However, in special tests conducted at the Anocut Engineering Co., holes were successfully produced by the electrolytically assisted grinding process. Both the wheel used and the hole obtainable are shown in Fig. 6.

The test was conducted on a Delta drill press that had been modified to provide a speed of 3000 sfm to the 1 1/2-inch diameter, metal-bonded cup wheel. Current was supplied from an Anocut power unit to the spindle by means of a slip ring and two automotive starter brushes. Plastic sheets placed beneath the work and the

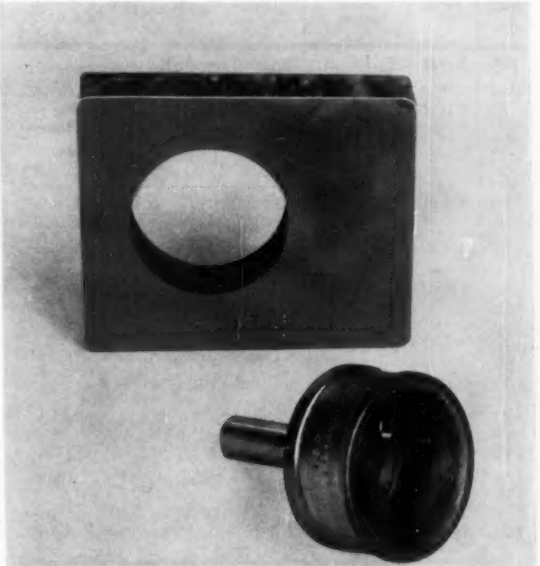


Fig. 6. This clean hole was made through a honeycomb sandwich by electrolytically assisted grinding techniques. Angular holes in the top surface of the metal-bonded cup wheel (foreground) directed the special electrolytic coolant to the cutting edge.

Table 1. Drilling Tests in Honeycomb Cores Filled with Shell Epoxy No. 1001

Drill Speed, sfm	Feed, ipr	Hole Size, Inches	Remarks*
150	0.003	0.512	Resin melted and stuck to drill
50	0.003	0.505	Resin melted and stuck to drill
50	0.009	0.506	Slight melting
50	0.009	0.499	Slight melting
50	Hand	0.519	Heavy through feed — resin did not melt
80	Hand	0.517	Through feed with oil coolant — resin did not melt
80	0.012	0.505	Oil coolant — no melting
70	0.012	0.500	Water coolant — no melting

*All holes had burrs at bottom due to brittle nature of resin. Subsequent tests with Shell Epoxy No. 1007 eliminated the difficulty.

NOTE: Results are based on the use of a 1/2-inch diameter drill having a 118-degree point angle and a 9-degree lip-relief angle.

clamping bars effectively insulated them from the machine.

In this process, a special water solution of non-corrosive electrolytic salts replaces the standard coolant. Material to be removed is stripped away by electrolytic action as current passes between the grinding wheel and the work being shaped. During the hole-grinding operation the coolant stream was aimed at the top of the cup wheel in which angular holes had been drilled to direct the flow to the cutting edge.

Table 2. Drilling Tests in Honeycomb Cores Filled with Sodium Silicate and Metal Powder

Drill Speed, sfm	Feed, ipr	Filler Metal	Remarks
150	0.003	Titanium	Excessive drill wear — honeycomb torn
75	0.003	Titanium	Slight reduction in drill wear — honeycomb torn
50	0.003	Titanium	Normal drill wear — tearing reduced
50	0.003	Stainless Steel	Normal drill wear — clean hole
75	0.003	Stainless Steel	Normal drill wear — clean hole
200	0.003	Aluminum	Normal drill wear — honeycomb torn
150	0.003	Aluminum	Normal drill wear — best hole in aluminum
50	0.003	Aluminum	Normal drill wear — honeycomb torn
75	0.003	Cast Iron	Normal drill wear — clean hole
150	0.003	Cast Iron	Normal drill wear — poor hole
50	0.003	Cast Iron	Normal drill wear — clean hole, accurate size
150	0.003	Cast Iron	Normal drill wear — clean hole, oversize

NOTE: Results are based on the use of a 1/2-inch diameter drill having a 118-degree point angle and a 9-degree lip-relief angle.

Good quality holes were produced in time periods varying from 1 1/2 to 2 minutes. Holes can be made in core ribbons as thin as 0.001 inch without burring. One difficulty was experienced in the form of arcing at the top of the cup wheel, which was made the same diameter as the cutting end. This diameter was merely reduced to eliminate the condition.

Core material may be drilled by conventional methods if rigidity is added through the use of metal-powder fillers. Table 1 presents the results of tests made with a 1/2-inch diameter drill having a 118-degree point angle and a 9-degree lip-relief angle. A filler of Shell Epoxy 1001 was melted in an oven at a temperature of 300 degrees F. It was then removed from the oven and poured into the honeycomb, with the core resting on a flat plate. Filling progressed satisfactorily with no apparent air pockets forming in the cells.

A second group of tests was made on a Buffalo drill press using the same drill specifications. Here, the honeycomb was bonded to an aluminum backing plate with an epoxy resin and was filled with a mixture of sodium silicate and powdered metal. The metal powder used varied with the individual test, and is noted in an appropriate column in Table 2.

Sawing—Another Way to Shape Honeycomb Structures

Sawing tests on honeycomb sandwiches were conducted on a DoALL band saw having a top speed of 10,800 fpm (feet per minute). The work was hand-fed into a 24-pitch, 1/32-inch thick blade operating at speeds ranging from 350 to 6000 fpm. Every cut left burrs that had to be removed by abrasive-belt grinding. The higher cutting speeds are recommended because they left the least burr and produced the cleanest cut.

Honeycomb cores present a slightly different problem. It is not desirable to saw this material parallel to the axis of the core cells with a toothed blade because of the excessive tearing action which occurs on the thin (0.002-inch thick) core ribbons. Such an operation would require substantial support of the cell walls.

Core material can be band-sawed parallel to the axis of the cells if a knife-edge blade is used and is operated at a minimum speed of 10,000 fpm. All types of knife-edge blades will work satisfactorily, such as a single-bevel, double-bevel, wavy-edge, and scalloped-edge. The single- and double-bevel edge proved best from the standpoint of cut cleanliness.

Band-sawing across the core—perpendicular to the axis of the core cells—has not been particularly successful due, mainly, to the absence of a kerf with knife-edge blades. It is suggested that the

Table 3. Band-Sawing Tests of Honeycomb Cores (Perpendicular to Core Axis) Using Single-Bevel Blade*

Saw Speed, fpm	Feed, ipm	Remarks
LOOSE BLADE GUIDES		
4320	Rapid	Crooked cut — straightened out when feed was reduced
5400	6	Straight cut — little burr
5400	6	Slight run-off
TIGHT BLADE GUIDES		
6120	8 1/2	Straight cut — slight burr
7560	15	Cut ran out
7560	6	Cut ran out
10,800	1.2 to 6	Cut ran out — unsatisfactory

*Mist coolant (Johnson's wax, 1:20 with water) was used in all tests at the rate of 40 drops per minute.

core material be fabricated to the required height rather than attempt to slice it to size with a band saw. Results of tests in which a single-bevel blade was used for cross-cutting core material are listed in Table 3.

Fillers Must Be Completely Removed

After machining cores that have been temporarily filled, the material must be completely removed. Two methods were employed to remove epoxy resins and Cerrobend (Cerrobend was used to mount the core for slicing tests, heading illustration)—oven-heating and steam-cleaning. In each case, a thin film (epoxy resin) or a few globules (Cerrobend) remained on the ribbons.

Blasts of hot air at a pressure of 20 psi and a temperature of 300 degrees F. also failed to remove either the film or the globules. The epoxy film, however, can be dissolved in methyl, ethyl, ketone, or acetone. It is recommended, therefore, that Cerrobend be avoided, due to the contaminating effect of the residual tin-lead alloys in subsequent brazing operations.

Iron-powder and sodium-silicate filler is easiest to remove. This can be done by immersing the part in boiling water for approximately thirty minutes, or by subjecting it to a water-steam jet for about ten minutes. The iron powder can be salvaged and re-used.

Conclusions

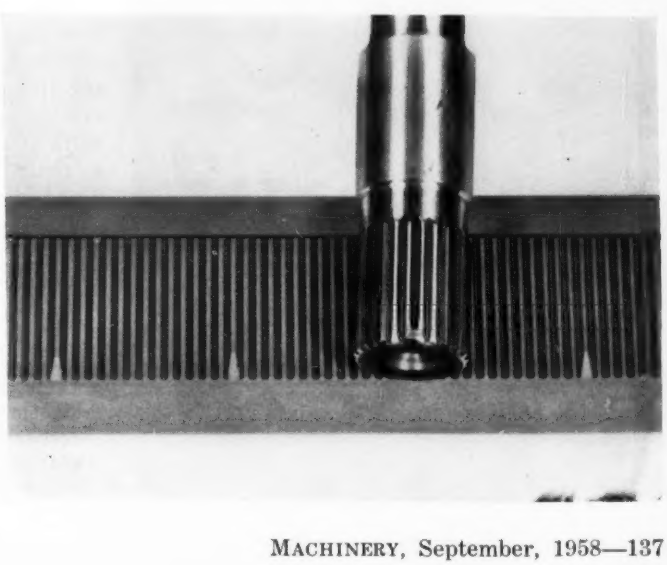
1. On the basis of extensive tests, it can be said that high-temperature honeycomb materials, both sandwich and core, can best be machined by electrolytically assisted grinding with metal-bonded abrasive wheels.

2. Rough-cutting the sandwich and core parallel to the core axis can be done on a band saw with commercially available blades, and at appropriate speeds and feeds.

3. Conventional shop equipment can be used to machine honeycomb cores if the cell walls are first supported by an adequate filler. Nevertheless this method is not recommended because the filler must be removed, and incomplete removal may contaminate subsequent brazing operations.

4. Where required, the core may be finished to a height tolerance of plus or minus 0.001 inch by means of a special slicing knife, followed by electrolytically assisted grinding.

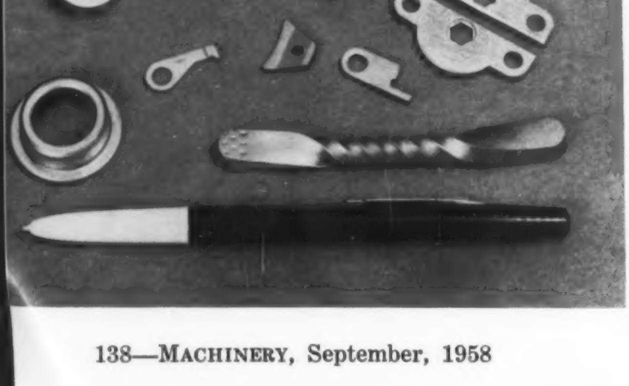
Splined parts are often designed with one or more teeth wider than normal to permit their assembly in only one position. A simple method for producing such splines by the Roto-Flo process of cold-rolling toothed parts has been developed by the Michigan Tool Co., Detroit, Mich. As illustrated, a double-width locating booth is produced on a splined part by a forming rack modified by grinding off the ends of those teeth which would normally produce the space between the two teeth. The resulting tooth-end permits easier location of the correct assembly position and prevents improper engagement of the spline. By blocking only the entry end of the tooth, nearly even pressures are maintained on the machine.



In a single pressing and sintering step, powdered-metal parts can now be produced with properties which approach those of wrought-steel alloys.

Sintered Ferrous Compacts Have High Density

NEW RAW-MATERIAL COMPOSITIONS are the secret behind the high densities and other properties obtained in the "Steelmet" powder-metallurgy process recently developed by P. R. Mallory & Co., Inc., Indianapolis, Ind. It is considered a major breakthrough for the industry, by closing the physical-properties gap that so far has greatly restricted the use of ferrous powder metallurgy for highly stressed parts.



These powdered-metal compacts, made in a single sintering and pressing step, approach the density of wrought steel alloys. Test bar above pen has been twisted severely without fracture to show ductility of the material.

Intricate parts have been produced by powder metallurgy for many years and at considerable savings because of the elimination of expensive machining operations. Fabricators have been using as raw material sponge, electrolytic or atomized iron, as well as several types of prealloyed iron powders. As compacted, however, the parts are porous, so that to obtain sufficient density, multiple pressing and sintering steps are employed. Another method for decreasing porosity is to add copper or brass to the sintered compacts to fill the voids.

With Mallory's new raw-material compositions, parts are produced which approach the densities of wrought materials in a single pressing and sintering step. A subsequent coining operation may be included, if close sizing of the work is needed, but the coining is not done to increase density, as is the case in ordinary powdered-metal practice.

The Indianapolis firm discloses that by a series of carefully controlled thermal, physical-chemical, and mechanical steps in preparing raw materials, a wide variety of iron-alloy composi-

Properties of Four Steelmets

	Steelmet 100	Steelmet 101	Steelmet 302	Steelmet 600	
Composition	1Mn-1Ni-Fe	9Ni-1Mn-Fe	302 Stainless	2Cu-0.25Ni-Fe	
Condition	As sintered	As sintered	As sintered	As sintered	Precipitation hardened
Density, g/cc	7.5-7.6	7.5-7.6	7.4-7.6	7.5-7.6	7.5-7.6
Theoretical density, per cent	95-96	95-96	96-98	95-96	95-96
Ultimate tensile strength, psi	50,000-55,000	78,000-82,000	75,000-90,000	68,000-70,000	85,000-90,000
Yield strength, psi*	30,000-35,000	68,000-70,000	35,000-37,000	52,000-55,000	82,000-88,000
Elongation, per cent†	30-20	12-8	30-15	20-16	7-3
Rupture modulus, psi	Too ductile to break	260,000	182,000	220,000	226,000
Hardness, Rockwell B	53-55	88-90	80-90	78-81	92-96
Izod impact, ft-lbs	10	6	22	8	2
Unnotched impact (modified Izod) ft-lbs	55	Bent only	90	Bent only	60
Fatigue strength, psi‡	27,500	40,000	35,000	37,500	45,000

*Yield strength is taken at 0.2 per cent offset.
†Standard MPA bar has 1-inch gage length.
‡Tests were for 10,000,000 cycles.

tions can be made. Compacts made from these powders are sintered to at least 95 per cent density. This densification is accompanied by a linear shrinkage of about 5 per cent. Further, compacting pressures are reduced—30 to 50 tpi (tons per square inch), instead of a 50 to 75 tpi range.

All of the powder compositions devised exhibit excellent green strength, permitting them to be compacted at high rates of production in automatic presses. Mallory has concentrated its research on developing Steelmets from the cheaper grades of powder, to provide as wide a market as possible. In some instances, basic modifications have been made of existing commercial iron powders, to give them the desired chemical and physical characteristics. Properties of four typical compositions now being produced in the company's pilot plant appear in the accompanying table. In the heading illustration, a technician inspects a part after compacting in the laboratory's 100-ton Kux press.

Foundry Technology Studied

An Applied Research and Development Laboratory for the study of advanced methods in foundry technology has been placed in full scale operation by the General Electric Co., Schenectady, N. Y. The laboratory is to provide the vital link between pure research and actual foundry practice in the improvement of materials and production techniques. A vacuum degassing chamber, 9 feet in diameter, is being used at the facilities to improve methods of eliminating gaseous impurities in molten cast metals.

Other projects under way include the development of vacuum melting methods and ways of processing cast alloys to reduce impurities and improve cast properties. Precision casting procedures and methods for reducing the quantity of metal needed for risers are under study as well.

Transfer Line for Railway Car Wheels

An automated, five-machine transfer line, designed to completely machine railroad car wheels at the rate of one wheel every ninety seconds, is being built by the Kearney & Trecker Corporation, Milwaukee, Wis.

Designed for the Standard Steel Works, Burnham, Pa., division of the Baldwin-Lima-Hamilton Corporation, the line will introduce a new concept in handling the wheels in vertical position. They will be automatically transferred.

Each of the five machines is actually a separate machine tool interlocked with load, unload, and inspection stations to operate as one machine. The following operations are performed in sequence: (1) loading, (2) rough-boring, (3) and (4) facing, (5) and (6) turning, (7) inspection, and (8) unloading.

Optical Dividing Head Controls Grinding Operation to 0.0001 Inch

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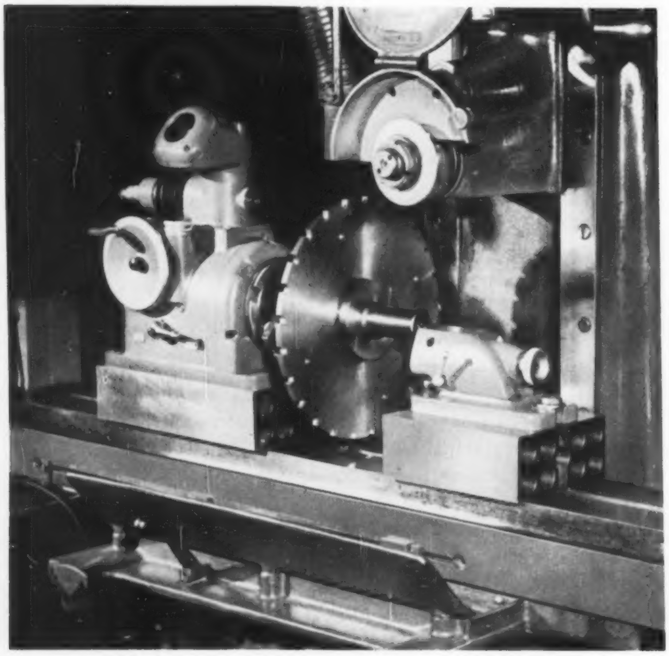
Barber-Colman Co.
Rockford, Ill.

REGRINDING the slots in a number of index-plates brought up the problem of accurate location. The plates were approximately 12 inches in diameter and had from 6 to 45 slots. As these were masters, it was necessary to hold the position tolerance of the slots to 0.00014 inch—or a spacing error of 5 seconds of arc between adjacent slots, and 10 seconds of arc between non-adjacent slots. One particular 23-slot plate had to be held to a spacing error of 5 seconds of arc between adjacent slots and 5 seconds of arc between non-adjacent slots.

To do this job, an Engis-Matrix optical dividing head was used. The unit was mounted on the table of a conventional surface grinding machine. Both the dividing head and the tailstock were set up on blocks, as can be seen in the accompanying illustration, to provide additional clearance for the large slotted index-plates.

Indexing accuracy may be read directly from a circular ground-glass screen in the instrument while work is going on. The graduations are permanently marked and protected so that there is no wear and no accumulation of errors. With readings of less than 3 seconds of arc (0.000015 inch per inch) the operator has close control of the work at all times.

Projection of a highly magnified image of the dial readings on a ground-glass screen eliminates the need for a conventional focusing eye-piece. This direct-vision, fixed-focus screen also eliminates errors due to parallax and makes it possible for two or more operators to view the same setting simultaneously. Both the tailstock spindle and the dividing-head spindle are enclosed to insulate them from grinding dust and to permit continuous operation under a heavy flood of coolant should this be necessary.



Optical dividing head, mounted on blocks for additional work clearance, positions slots on master index-plate to 0.0001 inch for a regrinding operation.

HOLES BY THE THOUSANDS . . .

are controlled by a single template

JACK BURNHAM
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AiResearch Mfg. Co.
Division of the Garrett Corporation
Los Angeles, Calif.

A UNIQUE MACHINE is being used to drill many thousands of holes in specific patterns in the shops of the AiResearch Mfg. Co. Thirty in-line spindles are contained in the drill head and extend across the width of the machine table. Choice of the particular drills to be activated for each phase of the cycle is controlled by a perforated steel template wrapped around the huge drum type spindle selector shown in the heading illustration.

This machine had its origin a number of years ago as the result of a contract to manufacture oil coolers for the B-29. Production of the aluminum oil coolers—which were to replace obsolescent copper and brass units—necessitated drilling thousands of holes in the header and support plates. Company engineers presented the Moline Tool Co. with a set of specifications for a multiple-spindle machine to handle the plate-drilling operations economically. Resulting from this coordinated effort was the illustrated rotating-drum drilling machine.

Until the new machine was placed in service, fifteen single-spindle drill presses had been required. This was in addition to the many jigs needed to accommodate various hole patterns. These patterns were to be drilled through elliptical oil-cooler plates ranging in size from 150 to 400 inches in circumference, and through circular oil-cooler plates ranging in size from 10 to 22 inches in diameter.

Hole patterns on twenty different plates are now being drilled on the rotary-drum machine. The holes necessary to form a desired pattern are produced in a series of feed strokes—each stroke drilling a straight row of holes across the surface of the work. Because only certain drills are to be used for each particular row of holes, a means of choosing the individual spindles must be provided. It is the purpose of the perforated steel template to control their selection. This is done by using a combination of through holes and dimples as can be seen in the template in Fig. 1.

Unlike normal drill-press feed movement, during which the drill is brought down into contact with the stationary work-piece, feed movement on this machine consists of elevating the work-table toward the spindle-selector drum by cam action. The drill head, being mounted on the same slide as the work-table, is elevated simultaneously.

When the drill spindles reach the selector drum, the shanks of those spindles aligned with template holes pass through them. Spindle shanks that are aligned with dimples have their

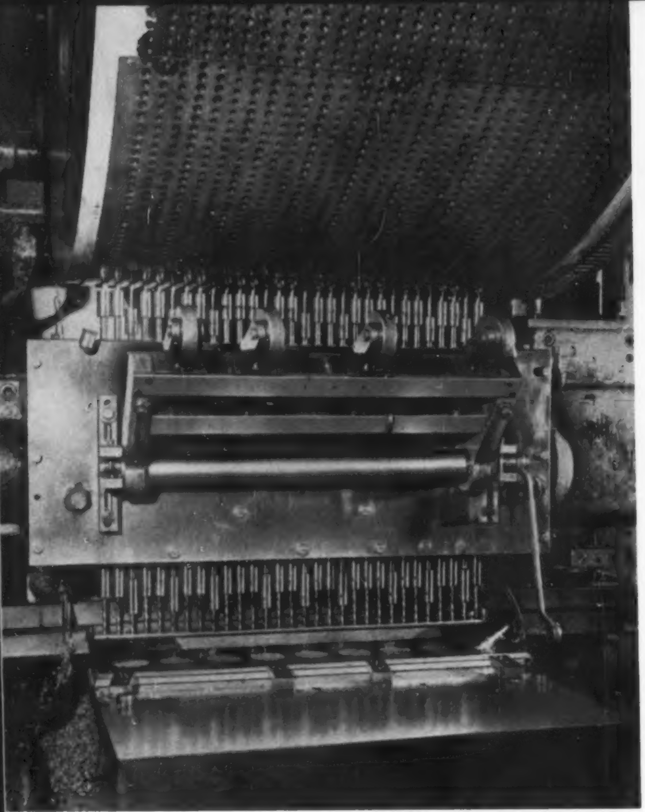


Fig. 1. Thirty drill spindles are aligned beneath the drum type spindle selector of the unique drilling machine shown in the heading illustration. A total of 5400 holes, grouped in patterns, can be drilled through stacked plates in three minutes.

upward movement arrested. Consequently, continued elevation of the work-table forces the work-pieces into contact with only those drills that have butted against dimples in the steel-plate template. This can be clearly seen in Fig. 2. (It should be noted that the front cover plate has been removed to expose the spindle-drive mechanism. Also, for purposes of illustration, the drills have been fed behind the work-pieces.) Since all the spindles rotate continuously, the drills begin their work immediately.

The end of the spindle that contacts the template is fitted with roller bearings, thereby remaining stationary while the spindle rotates. Power is transmitted to the drills by a large, horizontal driving worm located to the rear of the spindles (Fig. 2). A worm-gear is carried on each spindle and engages the driving worm, thus providing constant rotation.

A key, machined in the bore of each worm-gear, engages a long keyway on the spindle shaft, Fig. 3. This permits the rotating spindle to move vertically through the worm-gear.

A spring is mounted on the upper portion of each spindle. This is compressed when the spindle is forced downward by contact with the drum template. As the work-table is lowered, the spring returns the spindle to the same position as the non-working spindles.

Although the center distance between the required holes is 0.250 inch, the drills are spaced 0.750 inch apart. Therefore, the work-table must undergo two indexing movements to the side to complete the drilling of each row of holes. A cam arrangement beneath the table controls this lateral motion.

After each feed stroke has been completed, the selector drum is indexed to bring a new row of perforated holes in line with the drill spindles. Lateral movement of the work-table is synchronized with the indexing of the selector drum. When the drills have made the three feed strokes necessary to complete one row of

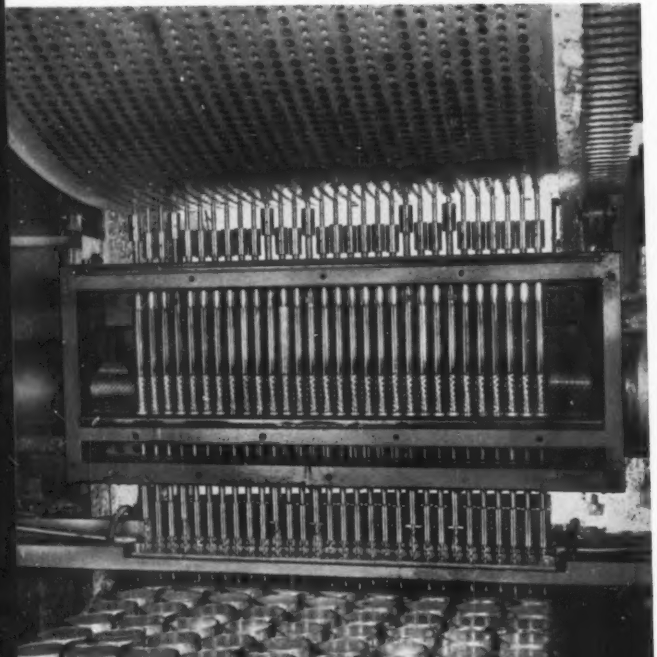


Fig. 2. Work-table and drill head are mounted on the same slide. As they approach the selector drum, those spindles aligned with template holes pass through; those aligned with dimples are halted, then contact the still-rising work-pieces.

Fig. 3. Principal operating members of the spindle assembly. Key in the worm-gear engages keyway on the spindle to allow simultaneous rotation and feed. Coil spring returns the spindle to its original position as the work-table is lowered.

holes, a rack-and-pinion mechanism advances the table and work-pieces one notch to begin the three-step drilling of the next row of holes.

Oil-cooler equipment for each B-29 required 5400 holes, 0.217 inch in diameter. This number of holes can be handled in three minutes. In the interest of economy, the parts to be drilled are clamped in a stack on the work-table. A setup time of only two hours is required for each type of header plate being worked.

* * *

Large Powdered-Metal Parts Formed by Brazing

A new brazing process is now being used to make larger powdered-metal parts by combining smaller Oilite units. In addition, new intricate shapes are possible and press capacity is no longer the size-limiting factor. The successful silver-solder bonding process was developed jointly by the Amplex Division of Chrysler Corporation and the Apex Bearings Co.

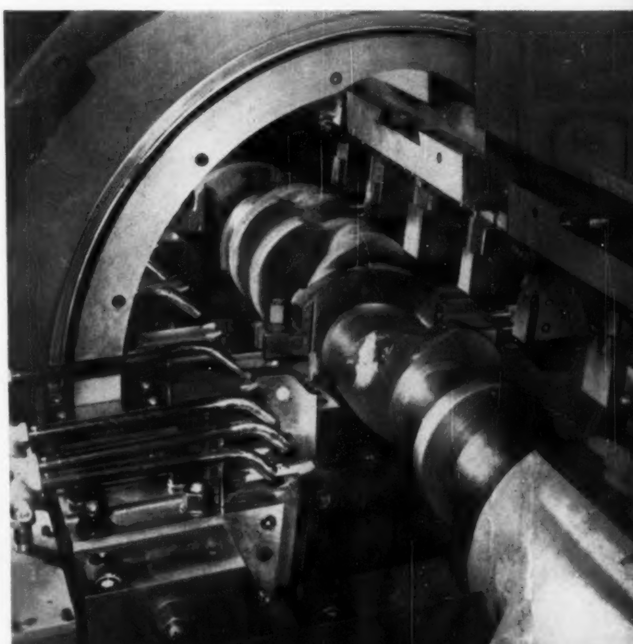
Center-Drive Bearing Lathe Performs Multiple Operations

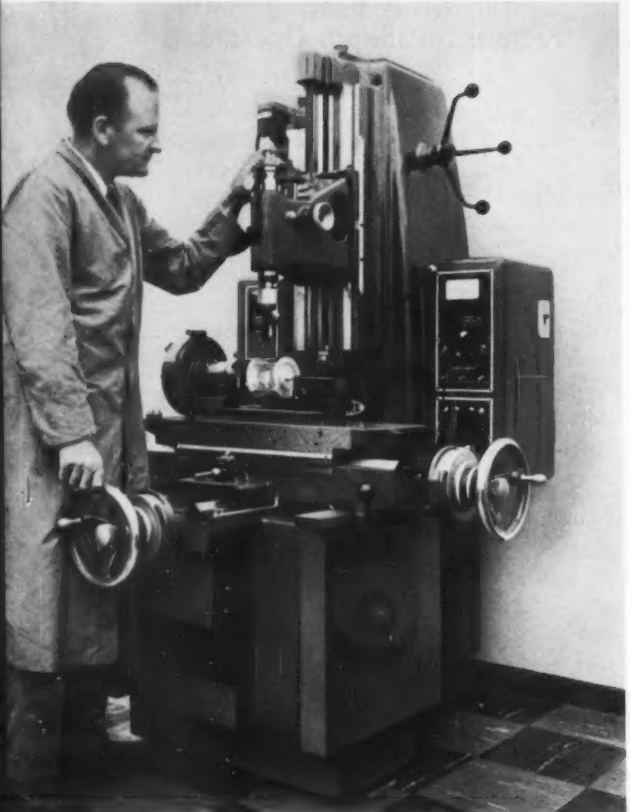
Two machining operations on forged-steel crankshafts have been telescoped into one at the Caterpillar Tractor Co., Peoria, Ill., with a Wickes double-housing, 36-inch center-drive bearing lathe. The service of only one operator is required while the machine faces the crank cheeks and turns and fillets all bearings, flanges, and stub ends simultaneously. Shifting to another type and size crankshaft requires the replacement of special tool-mounting plates that have been pre-set and stocked in the tool-crib.

Crankshafts are placed in the machine by a push-button controlled, hydraulic loading arm. Once in the machine, the crankshafts are chucked on previously milled spots and turned at speeds ranging from 18 to 24 rpm. Life of special high-speed steel form tools ranges from ten to fifty shafts.

A feature of the machine is its control of feed rates. After initial manual adjustment, the feeds are automatically compensated to meet varying metal hardnesses or changed crankshaft specifications. The feed mechanism is controlled electrically through cams.

Special mounting plate simplifies tool changes when roughing different sized crankshafts. Gang tools simultaneously face the cheeks and turn and fillet all bearings, flanges, and stub ends.



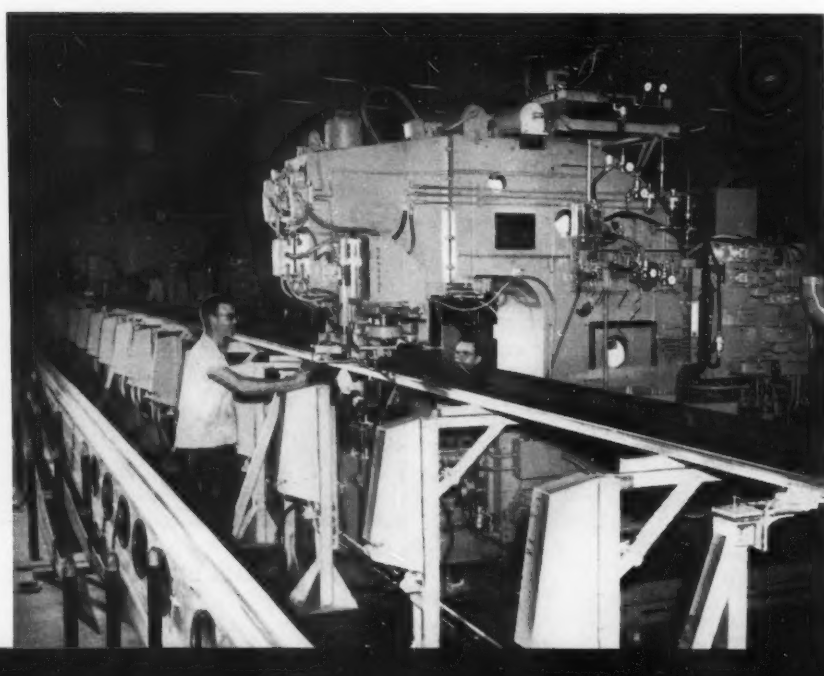


IN SHOPS AROUND THE COUNTRY

Camera highlights of some interesting operations performed in various metalworking plants

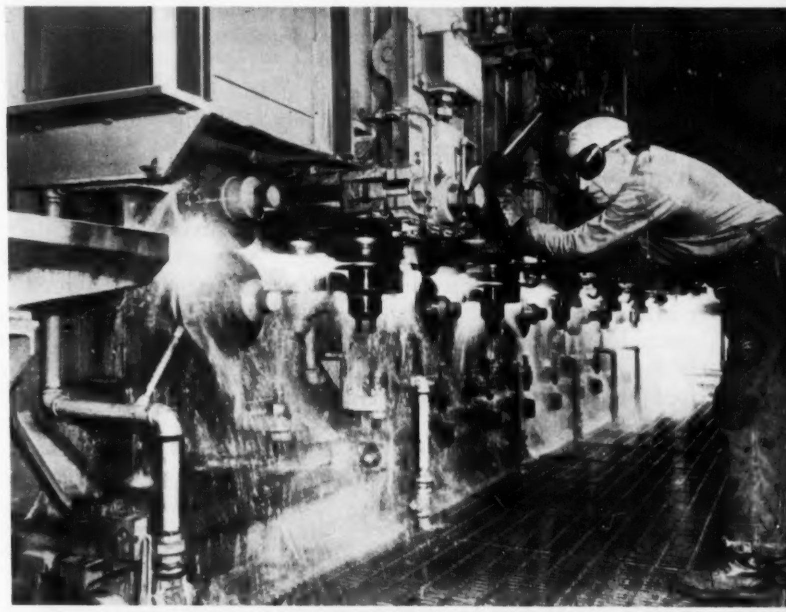
SENSITIVE INSPECTOR—Checking a gimbal for an inertia-guidance system in the inspection room of Sperry Gyroscope Co.'s Marine Division, Roosevelt Field, N. Y. Alignment and straightness of surfaces and holes are measured directly by coordinate positioning of table and rotation of an electronic indicator. Machine spindle, concentric within 0.000005 inch, is borne by 400 steel balls. So sensitive is this machine that an increase in the number of people in the inspection room will affect its accuracy.

AUTOMATIC RIVETER—Stiffeners are fastened to lower wing panels for B-52 Stratofortresses on a battery of four General numerically controlled riveters, at Boeing Airplane Co.'s Wichita, Kan., plant. Each machine automatically drills and countersinks a hole, inserts a rivet slug, upsets both ends, shaves off the outer head, and then indexes to the next rivet location. Larger sizes of rivets are refrigerated before being driven.



SHEET LIFTER—Colson Corporation, Elyria, Ohio, makes a one-man job of feeding a shear, thanks to this "Liftable" made by the company's Special Products Division, Somerville, Mass. Sheet stock is loaded on the device, which the operator adjusts vertically to bring the top sheet slightly above the height of the shear table. The Liftable's muscles consist of four hydraulic rams with connecting stabilizers.

FLASHY JOB—A worker at the Aliquippa, Pa., Works of the Jones & Laughlin Steel Corporation tightens a forming roll on one of two new continuous-weld pipe mills. The mills cost $17,000,000, and up J & L's welded pipe capacity to 35,000 net tons per month. One mill has ten stands, and the other, fourteen.



CASTING CLEANER—The castings going up the escalator to a 72-inch continuous Rotoblast barrel are part of the 400-ton daily production of the gray-iron foundry at International Harvester Co.'s Milwaukee Works. Inside the barrel, two 19 1/2-inch wheels throw approximately 100,000 pounds of abrasive steel shot per hour.

Pilots for Progressive Dies

FEDERICO STRASSER

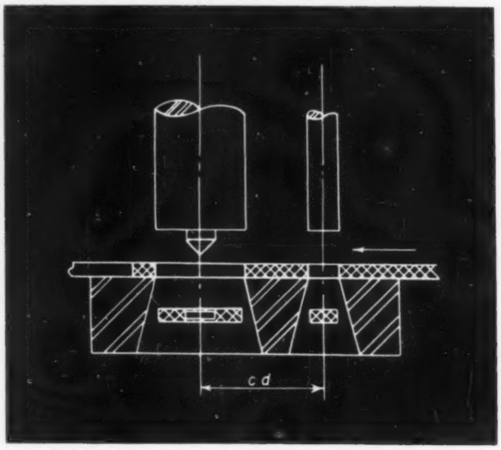


Fig. 1. The pilot is carried on the bottom of the blanking punch and enters the hole previously pierced in the strip.

OBTAINING accuracy and uniformity of stampings produced with progressive dies frequently depends on proper piloting. Pilots serve to align the metal strip positively, so that previously pierced openings can be correctly positioned beneath the blanking punch. Any side play or small inaccuracy in the feed of the strip can be compensated for by pilots. Where automatic feeding devices are used, pilots are strongly recommended, since they eliminate the need for stopping devices. Piloting can be either direct or indirect, depending on whether or not the pilot is integral with the punch.

Direct Piloting

The direct type is found in simple progressive dies, such as those for producing a round disc having a concentric hole, Fig. 1. The hole is pierced in the first station. Then the strip is advanced by the amount of center distance *cd*, bringing the hole under the center of the blank-

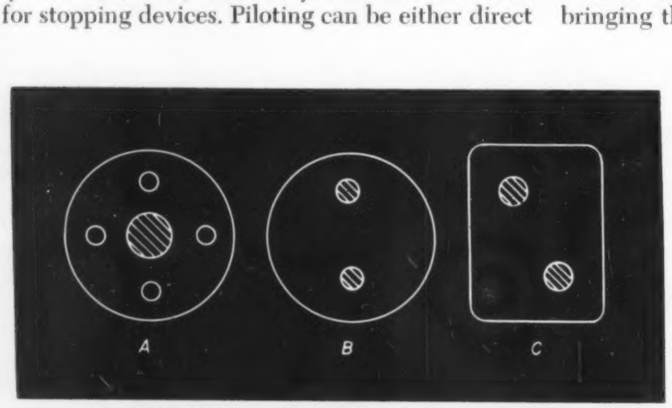


Fig. 2. A central hole requires only one pilot. If there are two holes off-center, two pilots are required. Two pilots will preserve a required relationship of the pierced holes with the blank periphery.

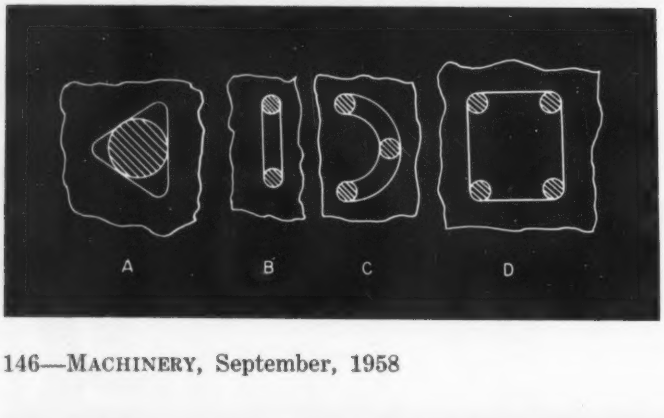


Fig. 3. To simplify their construction, pilots need not follow the pierced contour, but merely serve to give the strip positive location for the blanking.

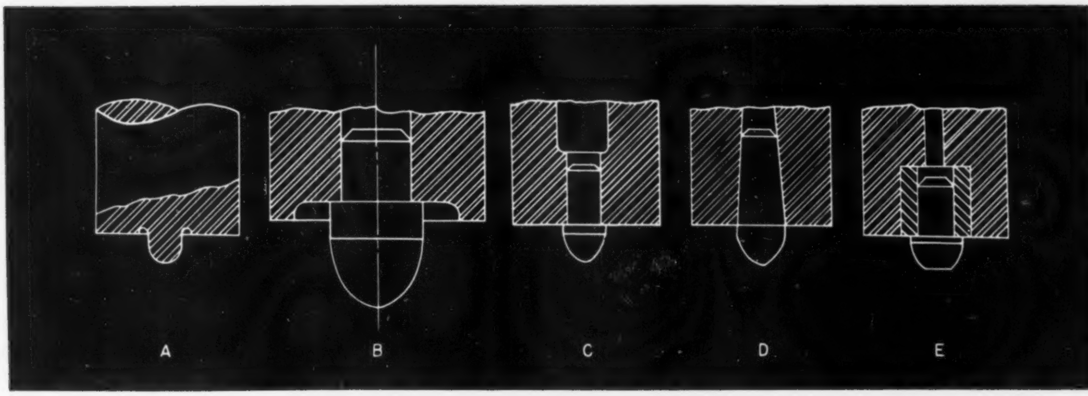


Fig. 4. The direct pilot can be an integral part of the blanking punch, or be secured to it by various means.

ing punch. When the ram descends, the pilot—a pointed plug corresponding in body size to the diameter of the hole—enters the hole and thus assures that the outside and inside of the disc are perfectly concentric.

If the work-piece has several pierced holes, one of which is central, View A, Fig. 2, a single pilot suffices. But if there is no central hole, as in View B, then two pilots are required. Likewise, if the pierced holes have a specific location to the blank periphery, as in View C, two pilots are required.

Should the pierced hole be a non-round shape, View A, Fig. 3, a round pilot can still be used. This simplifies its construction. Or if the piercing takes the form of a slot, View B, or a curve, View C, two or three round pilots do the job. Four small round pilots in the corners of a pierced rectangular hole, View D, substitute well for a more elaborate single pilot.

The above illustrations apply to two-station (piercing and blanking) progressive dies. Where more stations are involved, pilots should be provided at the intermediate stations as well as at the blanking station.

In design, the pilot can be integral with the punch, as in View A, Fig. 4. While it is satisfactory for short runs, the drawback of this type of pilot is the difficulty it creates in regrinding the punch. A better design is shown in View B. Here, the central area of the punch bottom is relieved. For long runs, a separate, easily removable pilot is even better. A press-fitted pilot, View C, can be used, although its assembly is difficult, since the pilot as well as the punch must necessarily be of hardened steel. By tapering the pilot body and its socket in the punch, View D, assembly is made easier. Another way is to introduce a soft bushing between the pilot and the punch, as in View E.

Various other methods of fastening the pilot to the punch are shown in Fig. 5. In View A,

Fig. 5. Pilots which can be detached permit the blanking punch to be reground easily.

the pilot is a sliding fit in the punch, secured axially by a countersunk screw. Or, as in View B, the pilot can have a long, threaded shank which is engaged by a nut. A simple set-screw through the side of the punch, View C, will also secure the pilot. If the diameter of the punch is large enough, a shouldered pilot can be used, View D, being held in place by a threaded bushing screwed into the bottom of the punch. Finally, in one of the simplest designs, View E, a long, shouldered pilot can be inserted through the top of the punch.

Spring-loaded pilots will safely retract into the blanking punch, should the piercing punch at a previous station break or fail to operate. This prevents the pilot from striking solid stock. Three designs are illustrated in Fig. 6. Such pilots lack the accuracy of the fixed type, since the sliding action introduces a certain amount of play. While they should be avoided, if possible, on stock heavier than 0.060 inch their use is almost compulsory.

Sometimes the pilot cannot be round in cross-section, and must conform to the particular shape of the pierced hole. Here, the pilot must be prevented from turning in the blanking punch. This can be done with a set-screw (as in Fig. 5-C) or a cross-pin. If the pierced hole is large, the pilot can be screwed into the punch bottom and aligned with two dowel pins.

In addition to the preferred design of making the punch removable to facilitate regrinding of the blanking punch, the pilot should be adjustable axially. The reason: the distance from the tip of the pilot to the bottom of the punch can be maintained each time the latter is reground. In this respect, the designs shown in Figs. 4-C, 4-E, 5-A, 5-B, 5-C, and 6-C are superior to the others.

As to its profile, the pilot has one of the basic forms shown in Fig. 7. In each instance, the top of the taper is continued by a short straight portion which does the actual piloting. Approximate dimensions of the tip are as follows:

D = 0.001 inch smaller than pierced hole diameter;
$d = 2/3\ D$;
α = 20 to 30 degrees;
$R = D$;
$r = 1/4\ D$;
$L = 1/2\ D$ (or five times stock thickness; in no case less than 3/16 inch, or more than 1/2 inch);
A = 1 to $2D$.

In regard to the length of the straight piloting portion x, there is disagreement. Some feel it should equal or exceed the stock thickness;

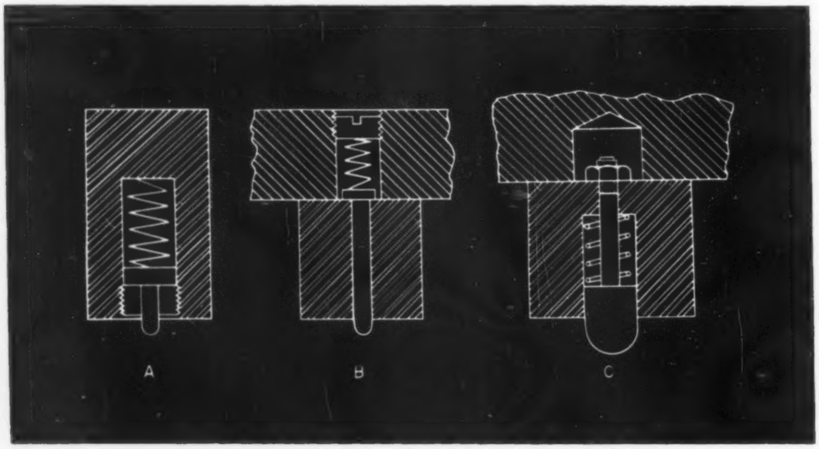


Fig. 6. While not as accurate as the fixed pilot, the spring-loaded pilot can retract safely into the blanking punch, should the piercing punch fail.

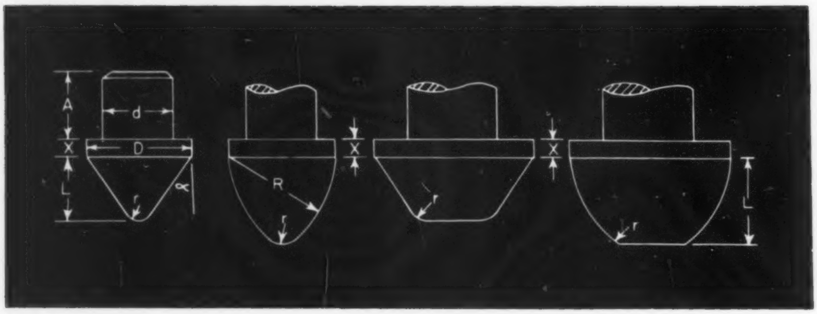
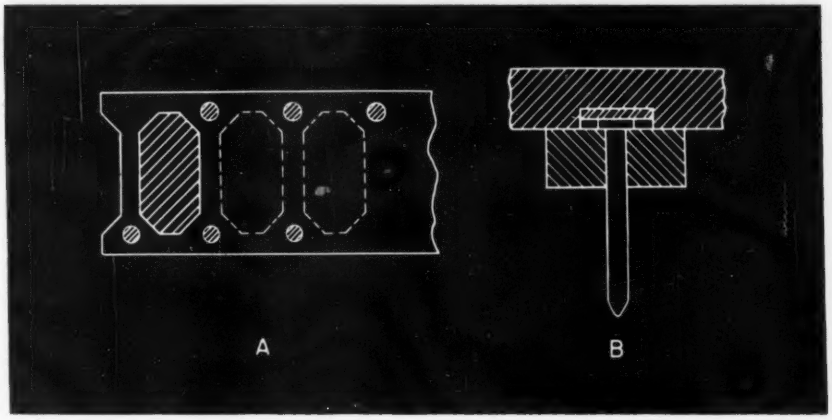


Fig. 7. Pilot-tip profile variations. The two on the right have flattened ends, and are used on larger pilots. In each instance, the straight portion (x) does the actual piloting.

Fig. 8. Indirect pilots are located near edges of the strip scrap and resemble conventional piercing punches except for their tips.



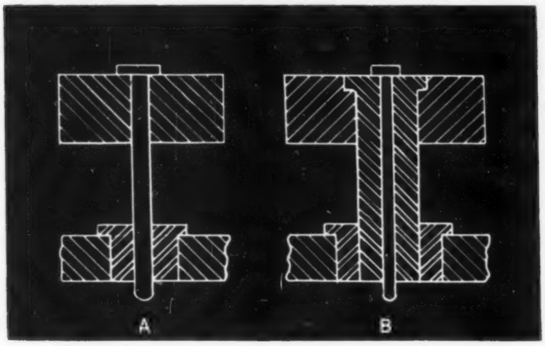


Fig. 9. Longer than the fixed pilot, the indirect pilot requires a guide bushing, and if slender, a quill too.

others prefer it at three-fourths stock thickness. Proponents of the longer portion claim better piloting. Those who favor a shorter portion claim that this prevents the blank from sticking to the tip on the press up stroke.

Indirect Piloting

Pilots are not always put into blanking punches, but often are fully separated from them. In such cases the holes which receive the pilots are usually located in the strip scrap, close to its edges, as in View A, Fig. 8. There are always two pilots, carried by the punch holder like ordinary piercing punches, as in View B. They enter their holes before the blanking punch reaches the work, thus assuring proper alignment of the strip.

While the extra punches and holes in the die needed for indirect piloting tend to increase its cost, their use is advisable where the holes pierced in the stamping pattern are small (less than 1/8 inch in diameter); where the holes are too near the stamping edge or too near each other; or where the holes must be absolutely free from distortion. Another use for indirect piloting is where there are no holes at all in the stamping pattern.

Diameters of indirect pilots should be about one and one-half times the stock thickness; in no case less than 3/16 inch. Pilots should be located as far as possible from each other, preferably, diagonally opposite. Usually, the holes to receive the pilots are pierced in the first station of the progressive die, along with the functional holes pierced in the stamping itself.

Indirect pilots must be supported and guided properly. If 3/16 inch or more in diameter, a hardened steel guide bushing in the stripper is satisfactory, as in View A, Fig. 9. For a more slender pilot, a reinforcing quill should be used, View B. The profile of the tip on indirect pilots is similar to that of direct pilots, although the straight piloting portion (x in Fig. 7) can be quite long, because there is a conventional stripper included in the die.

Holes for indirect pilots do not always appear near the edges of the strip scrap. Sometimes the piloting is performed at an intermediate station between piercing and blanking, with the pilot engaging the pierced hole, as in View A, Fig. 10. And sometimes it is performed at the second station beyond the blanking. (An idle station immediately after the blanking station is necessary to maintain the strength of the die.) Further, combined direct and indirect piloting can be employed, View B, for optimum accuracy. (Although not shown in the view, actually there would be an idle station between the blanking and the indirect piloting.)

Other Suggestions on Pilots

If the pilot operates in conjunction with a stopping device, such as a pin, the pin should be placed so that the strip moves away from it

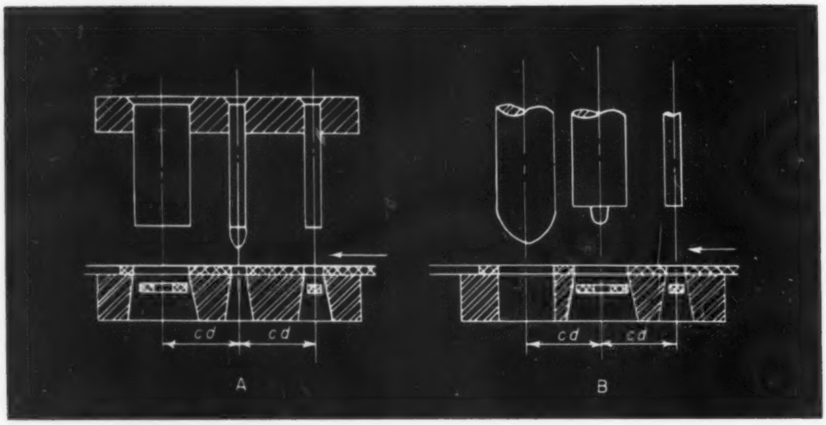


Fig. 10. Indirect piloting can be set up at a station between the piercing and the blanking. Optimum accuracy results from a combination of direct and indirect piloting.

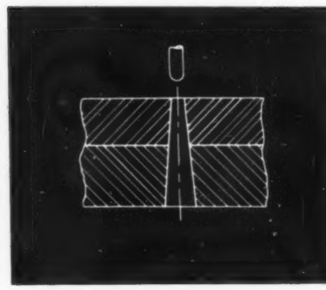


Fig. 11. Should the pilot have to punch a slug, an open hole will permit the slug to drop out of the die.

slightly (0.001 to 0.002 inch) when the pilot enters its hole. This avoids any cramping of the stock, hole distortion, or shear wear which would shorten the life of the dies.

In all applications of indirect piloting, the holes in the die receiving the pilots should extend completely through the die and the die holder, and should be tapered for clearance, as in Fig. 11. In case of a misfeed or break in a preliminary piercing punch, the pilot then has to punch out a slug. When there is an open hole, the slug can fall through. Also, chips and dirt will not clog the hole, as would be the case were it blind.

Finally, pilots should not be used on stock which is too thin (below 0.010 inch in thickness). In such cases, a hole can be easily distorted as the pilot enters to align the strip.

How Much Torque for Bolt Tightening?

HOW to determine the required torque for the proper tightening of bolts is a problem which has troubled manufacturers for years. A special report by the Skidmore-Wilhelm Mfg. Co., South Euclid, Ohio, points out that an over-stressed bolt can fail just as easily as one which is not tight enough. Therefore, the basic question in design is how much tightening torque will be required to develop optimum bolt tension. Size of bolt, type of nut and washer, and type of thread are given as the main factors in determining the proper torque.

Consider the manner in which energy is distributed when a bolt is tightened. If the hole alignment is correct, the thread fit not too tight, and clamping surfaces approximately parallel, the torque energy is distributed in three ways. About 50 per cent of the torque is absorbed in overcoming friction under the bolt head and approximately 40 per cent of the torque is absorbed in overcoming friction in the threads. Thus, according to the report, only about 10 per cent of the applied torque creates tension in the bolt. Therefore, relatively small changes in the friction under the bolt head, or in the threads, may have considerable effect on the resultant bolt tension obtained with a given applied torque.

Torque-tension data and its application, including a practical example, are given in the report. In addition, tables provide such information as the effect of different nut and washer combinations on the torque-tension relationship, and the ultimate strength of standard bolts. Copies of the report may be obtained, without charge, from the Skidmore-Wilhelm Mfg. Co., 442 S. Green Road, South Euclid, Ohio.

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A "tension control" system developed by General Electric keeps aluminum foil from tearing as it is rolled out to more than 100 times its length.

Versatile Tooling for Rabbeting Motor Frames

WITH an unusually flexible tooling arrangement, rabbets are machined simultaneously into both ends of electric motor frames at the Valley Electric Corporation, St. Louis, Mo. Minor modifications permit the setup on a Gisholt automatic lathe to accommodate eighteen sizes of three distinct part types having eleven different bores. The frames are made of both cast iron and steel.

Each motor frame is placed on an expanding arbor which is mounted on the spindle nose of the lathe, Fig. 1. Spacers are placed on the arbor to compensate for work-pieces of different length. In addition, an individual expanding bushing is used to adapt the arbor to different bores, Fig. 2. Each part is positioned with one end against a locator mounted on the headstock. During lathe operation this locator is retracted on an air-operated slide. The tailstock, also air-operated, is attached to the front carriage and is positioned longitudinally by the carriage movement.

Mounted on ball bearings, the tailstock quill is advanced to support the end of the arbor. A draw-bar arrangement operated through the center of the spindle expands the arbor to hold and drive the work-piece.

In addition to tools mounted on the front carriage, others are carried on an independently operated, longitudinal slide at the rear of the lathe. A pair of auxiliary longitudinal slides are attached to the headstock on opposite sides of the spindle. Two pusher bars, one held in the tool-block on the front carriage, and one held in the tool-block on the rear independent slide, are advanced to contact plungers that activate the two auxiliary slides. This action causes the tools on these slides to be fed toward the tailstock and into the work.

Tools on the rear independent slide advance first to rough-turn, face, and break the inner edge of the end of the motor frame adjacent to the tailstock. Simultaneously, the pusher bar on the rear independent slide activates the cutters on the rear auxiliary slide to perform the same operations on the opposite end of the work. Next, the front carriage and its tools are moved toward the headstock to finish-machine the end nearest the tailstock and to simultaneously activate the front auxiliary slide so that tools mounted on

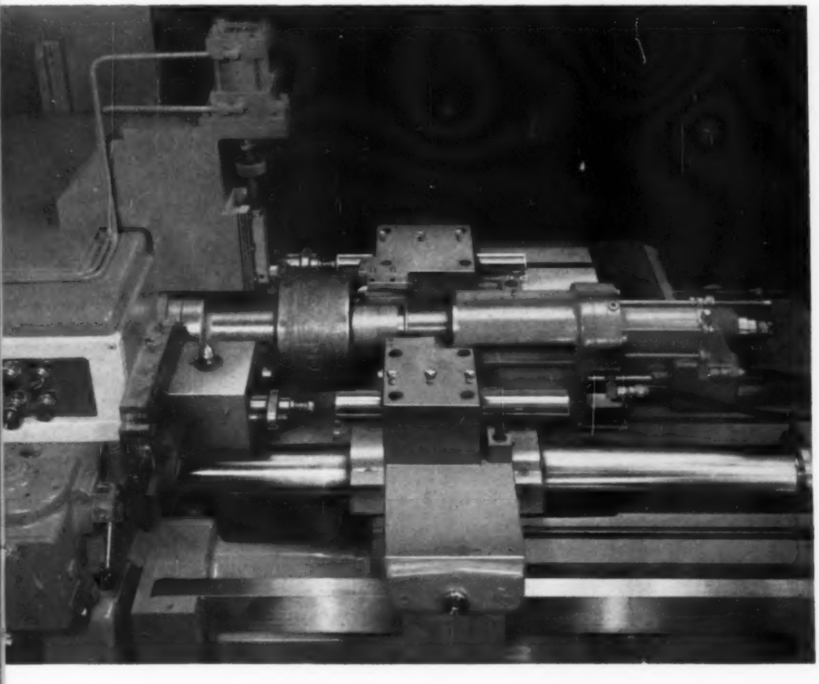


Fig. 1. Roughing and finishing of rabbets on electric motor frames are accomplished in one setup on this automatic lathe. Both ends of the frame are machined simultaneously.

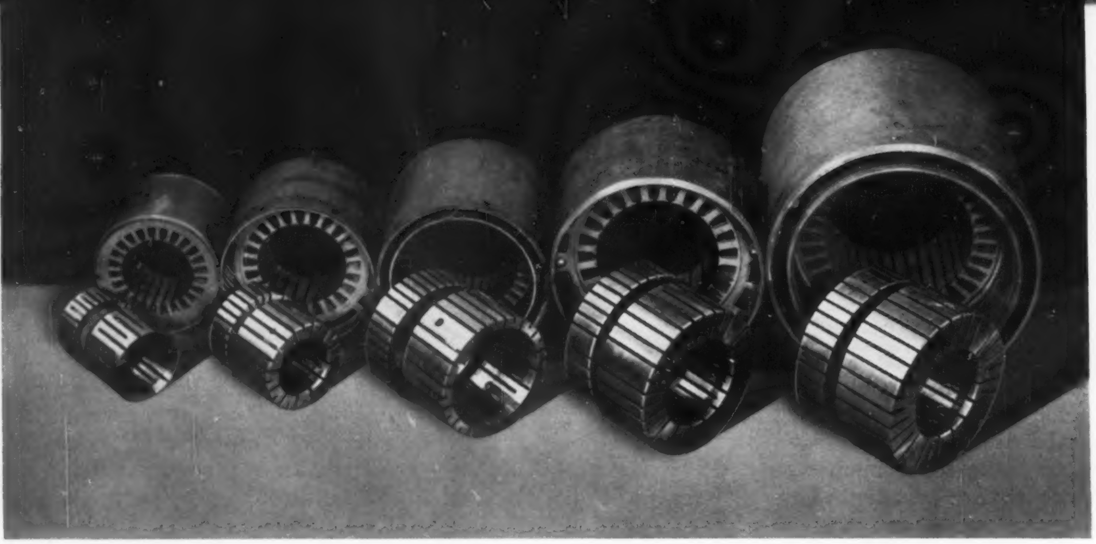


Fig. 2. Five finish-machined motor frames showing the variations in length and bore sizes. In front of each frame is the appropriate expanding bushing to be placed on the arbor for holding and driving the part.

it will finish-machine the rabbet on the other end of the frame.

Tool change-over for machining different sizes of electric motor frames, or for boring instead of turning the rabbets, is relatively easy and is accomplished in about thirty minutes for similar frames. When changing from single-end frames to those having two parts at each end and requiring both turning and boring operations on both ends, a somewhat longer time is necessary. The average floor-to-floor time for all eighteen different motor-frame sizes is about one minute.

Coil leads of a traction motor for a locomotive are tinned in a tank of molten solder prior to connection of the commutator. Surfaces not requiring tinning are sealed off, and solder is permitted to flow over the exposed leads. Flux is applied with a brush. This equipment at North Bergen, N. J., is part of the industrial locomotive overhaul facilities recently set up throughout the country by the General Electric Co.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Radius-Bar Attachment for Lathe Operations

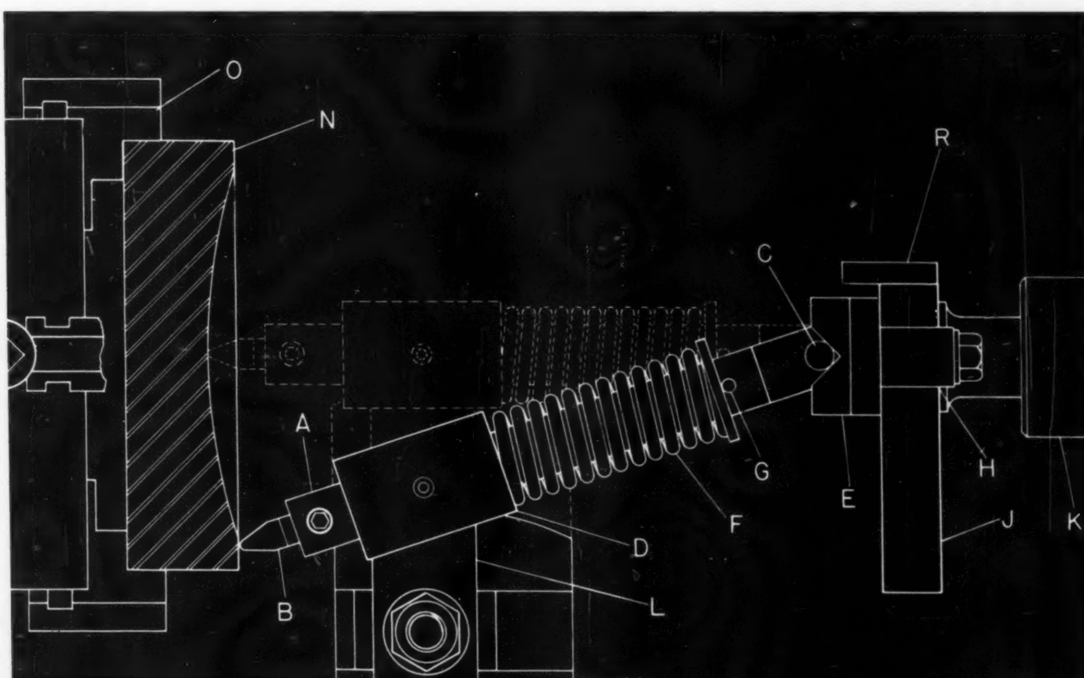
JOSE C. SOBKOWIAK, Jackson, Mich.

Machining concave surfaces requiring a high degree of accuracy is a difficult project for many small shops. The use of templates with the cut-and-try method is time-consuming, and in many cases the results are not too good.

The radius-bar attachment illustrated in Fig. 1 was designed for machining concave surfaces in a work-piece that is chucked in the lathe. With this device the maximum radius that can be produced is approximately equal to the maximum distance between the head and tailstock centers. Since the actual machining is done with the tool being moved across the work-piece by the power cross-feed, a high degree of accuracy and a good finish can be obtained.

The radius of the finished surface is determined by the length of the bar *A*. Measurements for setting the bar are made with a height gage, the distance from the end of the tool bit *B* to the center of the pin *C* being made equal to the required radius. The bar is machined to slide freely through a bored hole in the sleeve *D*, and a tongue is milled on one end to fit a slot machined in the V-block *E*. As this slot is horizontal and perpendicular to the V-groove, any vertical movement of the bar is prevented.

Fig. 1. A radius-bar attachment for turning concave surfaces in work-pieces chucked in a lathe.



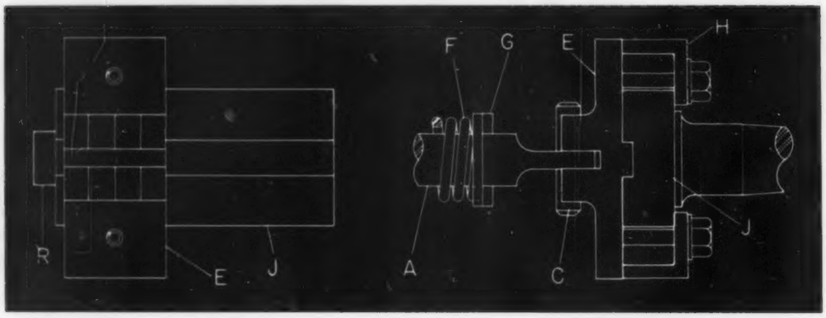
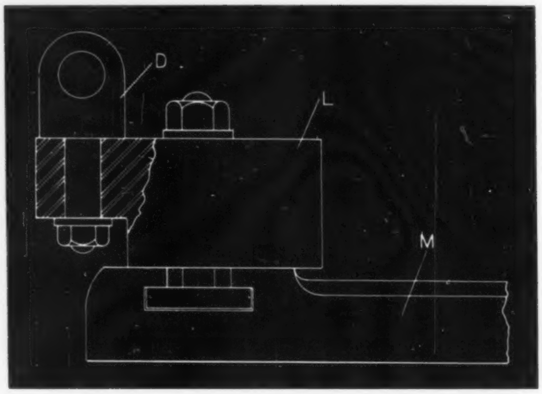


Fig. 2. (Left) Details of tailstock support for the pivoting arrangement of the radius-bar.

Fig. 3. (Below) Power cross-feed drives the radius-bar by means of the pivoting sleeve (D).

A compression spring *F* and a washer are located between part *D* and a dowel pin *G*, which passes through the radius-bar. Spring *F* causes the pin *C* to be held tightly against the V-block and permits a sliding action between the bar and the sleeve when a cut is taken.

The V-block is attached by two clamps *H* to block *J*, which has a tapered shank that fits the bore of the lathe tailstock *K*. A keyway is milled in block *J* and a matching key is machined on the V-block. The key and keyway allow for adjustment of the V-block to off-center positions (Fig. 2).



A nut, a washer, and the partially threaded shank on sleeve *D* are used to attach it to block *L* as shown in Fig. 3. The fit between these parts is such that the sleeve is allowed to swivel freely. Block *L* is bolted to the lathe compound *M* as indicated.

When machining a concave surface, the work-piece *N* is held in the chuck *O* and, starting at the outside of the work-piece, the tool is fed to the center by means of the power cross-feed. The depth of cut is regulated by the handwheel on the tailstock. To increase the cut depth, the tailstock spindle is moved toward the headstock. The attachment should be set up with the sleeve *D* placed as close to the tool bit as possible in order to prevent chatter. All moving parts should be lubricated freely.

To accurately locate the pivot point of the radius-bar, micrometer readings are taken over block *R* and V-block *E*. When the V-block is located central with the axis of the lathe, a reading should be taken and recorded. At this location, the radius-bar will produce a concave surface having its center in line with the lathe axis. The radius-bar can be offset to cut a groove of circular arc cross-section. In this case, the setover required is added to the initial reading of the micrometer.

Round nose tool bits having a radius of 1/32 inch and a cutting edge that is located at the horizontal center of the bar work well. The hole provided for the tool bit should be made deep enough to allow for some adjustment when setting the bar to cut the desired radius. It should be noted, however, that except where a minor adjustment of the tool bit is sufficient, a different bar will be required for each radius to be cut.

Eccentric Clamp Computations Simplified

KURT HEBER, West Berlin, Germany

Eccentric devices are commonly used for clamping purposes in jigs and fixtures. They are easy to produce and, if properly made, guarantee rigid clamping of the work-piece.

The tolerance on the dimension of that portion of the work-piece situated between the locating surface and the clamping surface determines the length of stroke S necessary for proper clamping with the eccentric member. The length of stroke of an eccentric clamp, in turn, depends on the eccentricity *E* of the clamping surface and its position angle *A*. In any application, however, proper clamping is obtained when the eccentric is self-locking. This can be assumed to occur if

the angle of friction α between the work-piece and eccentric clamp is equal to or less than 5 degrees 43 minutes. Substituting this value in the equation $E = \frac{D}{2} \sin \alpha$ (where D is the diameter of the eccentric) leads to the relationship that $D \geqq 20\,E$ for a self-locking eccentric clamp.

The diameter of the eccentric depends on the dimensions and the design of the jig but should be made as large as possible because of the better wear-resistance provided by a larger contact area. Position angles are limited by the operating range. It is important for the designer to have a clear conception of these factors in order to determine the proper dimensions of an eccentric clamp. Obtaining these dimensions by applying trial-and-error methods in the toolroom is both time-consuming and unnecessary. An easy way of finding the diameter and eccentricity of eccentric clamps is based on views 1, 2, and 3 of the accompanying illustration.

When the center of the eccentric is rotated about the center of the shaft from 0 to 180 degrees, the length of stroke increases from 0 to 2 E. In the middle position ($A = 90$ degrees), the length of stroke is equal to the eccentricity E. However, the length of stroke does not increase uniformly for each incremental angle during the rotation from 0 to 180 degrees. The curve of the rate of stroke increase is the curve of a harmonic motion. This curve rises very slowly up to a position angle of 60 degrees. Then the rate of increase is approximately constant up to a position angle of 120 degrees. From this angle to a 180-degree position angle the curve becomes flatter (rate of increase decreases) and levels off. Only in the range of 60 to 120 degrees does the eccentric rise uniformly for each incremental angle of rotation. Thus, for best results, the clamping range should be restricted to within -30 to $+30$ degrees of the middle position ($A = 90$ degrees).

The relation between clamping range angle B and eccentricity E for a fixed length of stroke S is illustrated in Views 4 and 5 which show the eccentric clamp at the two limiting position angles.

The vertical distance between the center of the eccentric and the horizontal line through the center of the shaft is equal to S′, or one-half the length of stroke S, if the position angle is $\pm \frac{B}{2}$ of the middle position. This is obtained from the relation

$$\sin \frac{B}{2} = \frac{S'}{E}$$

and as

$$S = 2\,S'$$

$$\sin \frac{B}{2} = \frac{S}{2E}$$

Example:

Given: $S = 0.020$ inch, $D = 1.600$ inches, $E = 0.080$ inch

To Find: B

Solution: $\sin \frac{B}{2} = \frac{S}{2E} = \frac{0.020}{0.160} = 0.125,$

$$B = 14^\circ\ 22'$$

As this clamping range angle is very small, B is chosen as 30 degrees. Then the eccentricity and diameter will become smaller.

$$E = \frac{S}{2 \times \sin \frac{B}{2}} = \frac{0.020}{2 \times 0.258} = 0.039 \text{ inch}$$

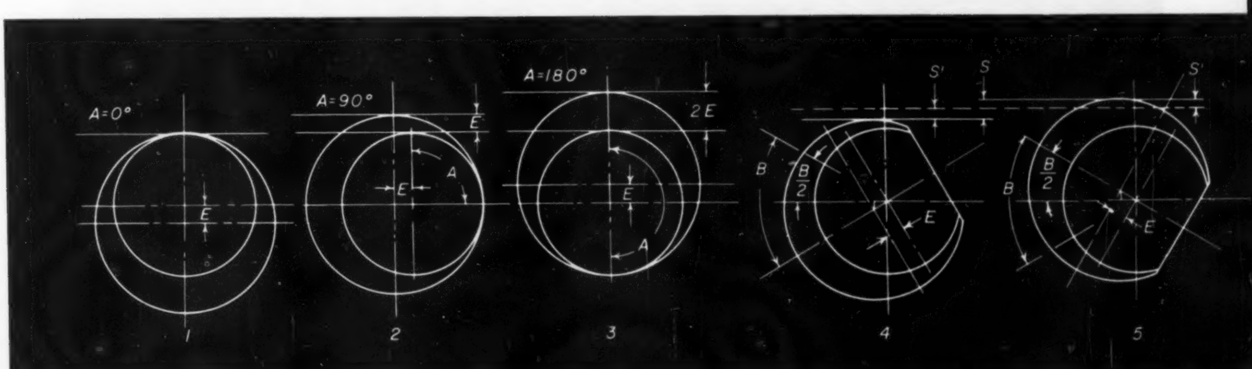
$$D = 20\,E = 20 \times 0.039 = 0.780 \text{ inch}$$

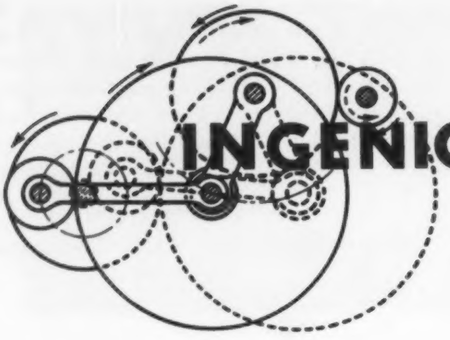
If the whole range of 60 degrees were to be used, there would be an eccentricity of

$$E = \frac{0.020}{2 \times 0.5} = 0.020 \text{ inch}$$

This method is a simple and easy way to obtain the most advantageous dimensions for clamping range angle, eccentricity, and length of stroke for every application of an eccentric clamp.

Eccentric clamps should be designed for a claimping range (B) located between ± 30 degrees of their middle position in order to obtain the greatest stroke possible for a given angle of rotation.





INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Ratchet and Two Pawls Control Movement of Indexing Fixture

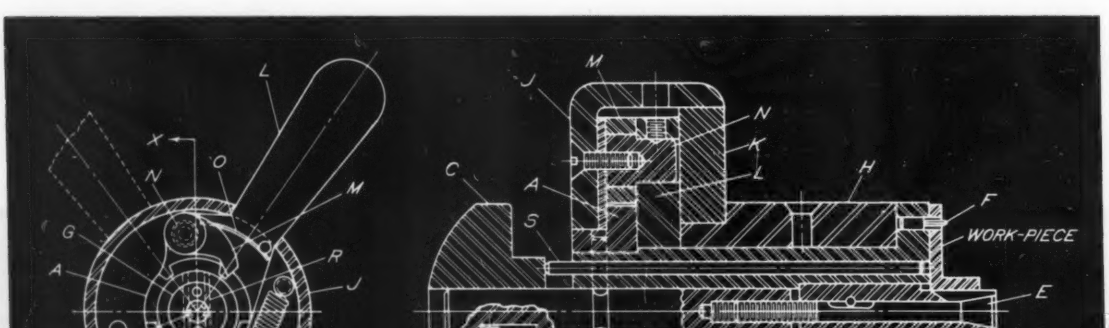
CLIFF BOSSMANN, Dayton, Ohio

Ratchet-controlled positioning and an expanding, work-holding stub-arbor are two features of the unique indexing fixture shown in the accompanying illustration. From two to eighteen indexing positions can be obtained, depending on the number of notches in ratchet plate *A*.

In this fixture the work-piece is gripped internally on an expanding stub-arbor *B*, shown in the enlarged Section X-X. The projecting portion of the arbor has three radial slots, giving it the action of a collet. Knob *C* is prevented from turning on shaft *D* by a full-dog set-screw, thereby causing both members to turn as one. The dog point of the set-screw is a sliding fit in a keyway machined in the shaft. When the knob is turned, the threaded end of tapered plug *E* is drawn into the shaft, causing the arbor to expand. Shaft *D* is restrained from sliding by dowel-pins *R*.

The work-piece illustrated is located through a hole in its flange by means of a diamond type locating pin *F*. This pin is pressed into the flanged face of rotating housing *G*—the entire sub-assembly being contained within fixture base *H*. The complete indexing mechanism is located between moving cover *J* and stationary plate *K*, and functions in the following manner.

Indexing of the work-piece is effected by movement of lever *L*. Pawl *M* rides on shoulder-stud *N* which, in turn, is locked to the enclosed part of lever *L* by a cone-point set-screw (Section X-X). Cover *J* also is locked to this shoulder-stud by means of a flat-head machine screw as shown.



Indexing fixture functions around the action of a notched-plate type ratchet wheel and two pawls—one driving and one locking. The work is held internally on an expanding stub-arbor.

When the lever is moved to the left, pawl *M* is disengaged from its notch in ratchet plate *A* and slides over to the next notch. Flat spring *O* is brazed to the pawl at one end and backed up by a pin at the other end to maintain downward pressure on the pawl at all times.

During this initial thrust of lever *L*, the ratchet plate is prevented from rotating by a tooth on the lower, spring-loaded pawl *P*. However, as the lever moves to the left, a cam surface *Q* at the lower end of the lever gradually disengages pawl *P*. Complete disengagement is timed to occur when pawl *M* drops into the next notch in the ratchet plate.

At this point, returning the lever to its original position will cause the ratchet plate to rotate clockwise a distance equal to the space between two adjacent notches. This indexing movement is imparted to housing *G* by two long dowel-pins *R* that connect the housing to the ratchet plate. As the lever moves to the right, the receding slope of cam surface *Q* permits spring-loaded pawl *P* to re-enter a notch in the ratchet plate, thus securing the new position of the work-piece.

After machining operations on the piece have been completed, it is released by first backing off knob *C* to relieve the expansive forces on stub-arbor *B*. Then, by striking the knob, ejector-pins *S* will move to the right and drive the work-piece off the arbor. Altering the number of index positions handled by this fixture would necessitate the replacement of ratchet plate *A* for one with the appropriate number of notches, and lever *L* for one with a modified cam surface *Q* that will effect engagement and disengagement of the lower pawl at the proper moment.

Counting Device Shuts Down Machine Automatically

RALPH T. STEWART, Winston-Salem, N. C.

The power supply to a textile machine making yarn is cut off automatically when a predetermined number of yards have been produced. This is done by a counter which controls a spring-loaded shaft connected to a switch.

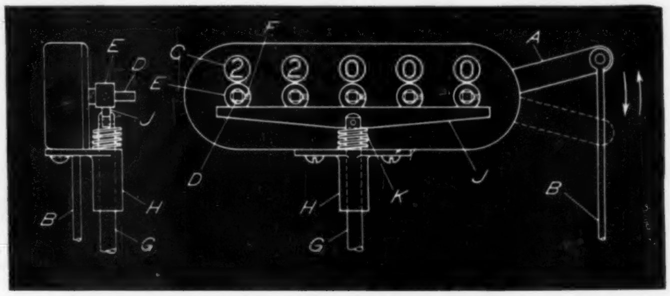
The counter is actuated by the up and down movement of lever *A*, joined to rod *B*, which reciprocates each time a yard of the yarn comes off the machine. This particular counter is a five-digit model (up to 99999). In the setting illustrated, the number 22000 appears in the windows *C*. Each digit is part of the circumference of a number-wheel, graduated from 0 to 9.

Beneath each window is a resetting pin *D*, which rotates in unison with its respective number-wheel. Thus, whenever a number-wheel moves, its pin rotates one-tenth of a revolution. The exposed ends of the pins are milled square to receive a key. Over each pin is a collar *E*. These collars have a flat on their periphery, and are secured to the pins by set-screws *F*.

Shaft *G*, contained in bearing *H*, at its lower end is connected to the electric switch (not shown). At its upper end, the shaft is pinned to transverse bar *J*. Spring *K* keeps the assembly normally raised, in which position the switch is open.

In use, the counter is first set to the number of units (yards) required. This is done by turning the pins with the key, and adjusting the collars by means of the set-screws until all the collar flats are flush against the transverse bar. The counter is next reset to 00000, in which position the flat on one or more of the collars is no longer flush with the bar. (For the number 22000, the flats under both 2's will no longer be flush.)

As long as the cylindrical part of the periphery of any of the collars contacts the bar, the bar is kept depressed and the electric switch is closed. Only when the predetermined number is reached are all flats again flush with the bar, and the switch is opened automatically.



The counter stops the machine when the flats on all pins (D) are flush with transverse bar (J).

SHOP KINKS

To save time in setting this 5-inch sine plate at 30 degrees, a special height block was used.

Special Height Blocks Convenient for Setting Sine Bars

H. J. GERBER, Stillwater, Okla.

Every time a sine bar or sine plate is set up, gage-blocks have to be sorted and stacked. These procedures can be greatly reduced if specially made height blocks are substituted for the gage-blocks when setting up such commonly required angles as 30, 45, and 60 degrees. The 5-inch sine plate shown in the accompanying illustration is seen set at 30 degrees with the aid of a special height block.

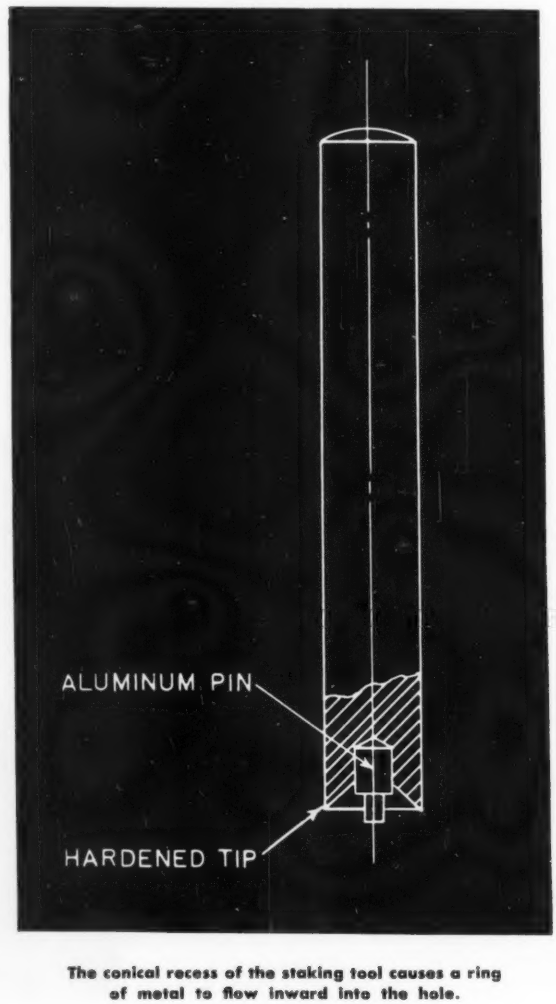
The block shown is one of a set of carbon tool-steel rods made for this purpose. These rods are hardened to 64 Rockwell C, artificially aged to prevent dimensional change, and ground and lapped on both ends. Great care was taken to make the ends parallel. The center portion of each rod is knurled for gripping purposes, and its height is stamped in flats ground on the sides for easy identification. Made for use with a 5-inch sine bar, the rods are of the following lengths: 2.5000 inches for an angle of 30 degrees, 3.5355 inches for 45 degrees, and 4.3301 inches for 60 degrees.

This selection of rods may be increased by adding others for angles frequently used in any particular shop but, generally, the above set of three will be sufficient. Their cost should be repaid many times by the labor they save in routine setups and measurements.

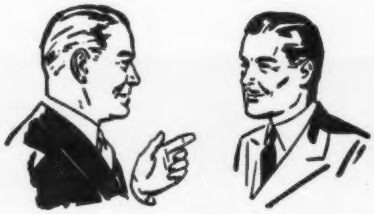
Staking Tool Repairs Bearing Holes

G. G. HERZL, Phoenix, Ariz.

Bearings for many inexpensive instruments are often only drilled holes in side plates. When worn, such holes can be returned to serviceable condition with the staking tool illustrated. The tool has a hardened tip, in the form of a conical recess. An aluminum pin centers the punch, but is necessarily smaller than the desired hole diameter. When the tool is hammered over the hole, the surrounding metal is forced inward, and the hole can then be reamed to size.



The conical recess of the staking tool causes a ring of metal to flow inward into the hole.



Talking With Sales Managers

BERNARD LESTER
Management Consulting Engineer

Prune the Product Line

THE SALES MANAGER for a builder of sensitive drilling machines recently received a personal note from an old friend who owned a small company. Attached was an order for an obsolete model of a machine still listed in the catalogue.

This incident lead to exposing and accentuating hidden losses that resulted from continuing to build and sell antiquated designs. The sales manager had pressed hard to get new designs to sell, but had neglected to eliminate losses encountered by continuing to offer inactive models.

Like the Australian who bought a new boomerang and tried to throw away the old one, he may find it harder to drop an out-dated or unprofitable item than to add a new one.

American business men are dimensional-minded. We cling to the idea that an increase in volume is essential to success. Progress has been made by setting up accounting systems which establish profit bogies for sales and economies. Even so, the accountants' figures fail to show that a small, special order often consumes overhead expense far beyond its importance. Also, our accounting systems fail to expose losses from interdepartment operating relationships which get more pronounced as the corporate structure becomes departmentalized. For instance, sales department operations can greatly affect manufacturing costs, and vice versa. Losses that occur in building out-dated types of equipment that continue to be listed and sold are prime examples.

When the sales manager for a foundry-equipment builder canvassed his sales force about discontinuing a particular item, the following comments came in:

"We still need it to round out our line."

"You will have to make replacement parts anyway, why not the complete machine?"

"We have a heavy stock of certain parts to use up."

"We are all used to selling this machine."

"The few we build take no time to sell, and help eat up sales overhead."

These comments illustrate the natural instinct of salesmen to seek the easiest path to added sales, especially when profit or loss is hidden. The sales engineer who cries loudest for economies in a new design is often the last to favor the abandonment of an old one which is costly. It pays to persistently examine each item you list for sale to see that it pays its way. Here are some suggestions:

1. Spot all slow-moving items to find the reason for their inactivity, especially the old standbys with dwindling sales.

2. Picture the costliness of handling infrequently sold items from the date of order to the date of invoice. Bring to light particularly what these infrequent orders mean to other departments such as design and manufacture.

3. Concentrate on those items which absorb the attention and time of high-priced employes and must receive special consideration all along the line. Don't neglect the engineer's time, which may be easily consumed in processing equipment orders rather than in developing new designs.

4. Don't let any costs of listing and selling an item escape you. For example, a check on the stock of printed material in the offices of so many equipment builders reveals piles of forms and instruction and sales promotional literature that will never be used.

5. A program of pruning the product line may expose weaknesses in individual salesmen. We know of one young salesman who succeeded in making a slow-moving item popular. Other salesmen had become prejudiced against this product and neglected it.

6. Above all, plan for the retirement and demise of any type or style by providing salesmen with convincing reasons that can be passed on to customers. How a product is withdrawn from the market can easily determine what happens to customer good will.

Regularity in pruning the product line is of far-reaching importance because it reveals the need for new and advanced designs. It can uncover reasons that block sales. It can expose hidden and expensive losses experienced by departments other than our own. It can lift the salesman's appreciation of profits in relation to volume. It is one approach to the current change in the demands for improved machinery.

THESE TWO Gould & Eberhardts hob spur and helical gears up to 72 inches in diameter and as coarse as 1 1/2 diametral pitch. A gear with a face width up to 45 inches can be hobbed on this equipment. Much of the work consists of worm wheels and sprockets, which can also be handled in the same size range.

FELLOWS gear shapers cut both internal and external spur and helical gears up to 36 inches in diameter and as coarse as 3 diametral pitch. Herringbone gears can also be shaped.

No gears in inventory....

Gear Plant's "Stock" Consists of Modern Equipment

ONE of the best-known specialists in the field of power transmission is the Cincinnati Gear Co. This company is now in its second half-century as a supplier of industrial gears and gear-boxes. It is located in a modern 60,000-square-foot plant in Mariemont, Ohio, a suburb of Cincinnati.

Many gear houses keep on hand for immediate shipment a variety of gears of standard design and specifications. "Cinti," however, is a custom manufacturer exclusively. All gears are made to order; none are kept in inventory. Shown here is some of the up-to-date equipment employed in generating, shaving, grinding, and inspecting gears, worms, splines, and sprockets.

THIS Michigan gear shaver accommodates gears up to 39 inches in diameter and shafts up to 71 inches in length. It is versatile in that it can crown shave to any desired degree. By using a special attachment, it is also possible to shave internal gears of a large size range.

GRINDING is an important tooth-finishing method at "Cinti." The involute of the tooth being ground on this Maag machine is actually generated from a base-circle segment. A rocking motion is used in conjunction with a feed of the work beneath a pair of thin wheels. Spur and helical gears can be ground up to 25 inches in diameter and as coarse as 2 diametral pitch. Tooth form can be modified with crown relief and tip and root relief.

WITH THIS Maag analytical gear tester, involute and lead of gears up to 41 inches in diameter are inspected and recorded automatically on a chart which becomes a permanent record. Such information permits making any necessary revisions in the finishing procedure to produce the quality required. Analytical inspection like this can accurately predict the noise level and the operating life of a gear.

No Gears in Inventory . . .

(Continued)

FUNCTIONAL INSPECTION for composite error, including such important details as concentricity, tooth action, and tooth spacing, is performed on this Parkson gear tester. This inspection is accomplished with the mating gear or a master gear, as required. After the composite check has been completed, the gears are rolled on the operating center distance to determine the exact bearing contact to be expected at final assembly.

NOISE in gears is detected by Gleason equipment in this sound-testing room. The gears are operated at the assembly rpm, and the amount of noise developed is measured on a decibel meter. Where noise in a gear assembly is critical, a specific decibel tolerance is established. Each gear set must conform to the noise specification or it is rejected.

NERVE CENTER of the plant is this production control board. It is revised on a regular schedule to reflect current information. When used with more detailed schedule boards, delivery dates can be accurately forecast. A pneumatic-tube system provides immediate communication between each department in the plant and a time desk in the production control center. Whenever a job is moved, the control center receives the information promptly.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Aluminum Casting Alloy with Strengths Approaching Those of Forgings

An aluminum casting alloy called "TENS-50" that can be sand-cast or permanent-molded to give strengths comparable to aluminum forgings has been introduced by Navan Products, Inc., 1318 Second St., Santa Monica, Calif. Typical mechanical properties for average sections varying in thickness from 1/8 to 3/4 inch for the sand-cast form are: ultimate tensile strength, 46,000 psi; tensile yield strength (0.2 per cent offset), 36,000 psi; ultimate shear strength, 41,000 psi; and elongation, 5 per cent in 2 inches. For the permanent-mold cast form, the following are the typical mechanical properties: ultimate tensile strength, 50,000 psi; tensile yield strength (0.2 per cent offset), 44,000 psi; ultimate shear strength, 44,000 psi; and elongation, 6 per cent in 2 inches.

Composite Die Sections for Cutting-Off, Blanking, and Forming

The Ohio Knife Co., Dept. EE-77, Cincinnati 23, Ohio, announces the availability of six standard composite sections for use in die construction. These sections, known as "O-Kni-Co" composite sections, are used for cutting-off, blanking, and forming. They may also be used for drawing and pinch trim dies, heels, flanging, backup plates, or as guides and hold-down gibs. O-Kni-Co sections may be used in many combinations. They are available in lengths up to 125 inches, and are delivered with the cutting or forming edge already hardened, machined, and ground. The soft-steel backing to which the specially hardened tool steel is bonded can be quickly drilled for dowel and screw holes.

Reverse-Current Cleaner for Heavily Smutted Steel

A reverse-current cleaner which provides good conductivity and surface activity and is particularly effective in cleaning heavily smutted steel has been announced by Oakite Products, Inc., 126 Rector St., New York 6, N. Y. Known as "Oakite Composition No. 190," it also removes fingerprints, light surface rust, and oxides resulting from spot or seam welding. It is used in concentrations of from 8 to 16 ounces per gallon of water, at temperatures ranging from 180 to 200 degrees F. with a reverse current per square foot of from 40 to 100 amperes. The material may be used with or without a precleaner, and after treatment, parts rinse well in hot or cold water.

Three Epoxy Resins Made Available for Tooling Applications

The Dow Chemical Co., Midland, Mich., has entered the liquid epoxy resin field by offering three basic resins which are said to be of special interest to the tooling, electrical, paint, adhesive, reinforced-plastic, and chemical industries. The first of these resins, identified as "D.E.R. 332," is unique in that it is water-clear, has good uniformity, and a very low viscosity. "D.E.R. 331" is a standard unmodified resin suitable for customary use in tooling, casting, bonding, and electrical encapsulation. "D.E.R. 334" is a modified low-viscosity resin especially suited for laminating in the tooling industry.

High-Strength Alloy Withstands Temperatures to 1350 Degrees F.

A consumable-arc vacuum-melted alloy that retains strength at temperatures up to 1350 degrees F. has been made available by the Westinghouse Electric Corporation, P.O. Box 2099, Pittsburgh 30, Pa.

"W-545," as it is called, can easily be fabricated for use in highly stressed parts of missiles such as turbine wheels, couplings, shafts, valve stems, and bolts, as well as parts of gas or steam turbines. It is non-magnetic, and its high yield-strength characteristics also make it useful for low-temperature applications such as retaining rings and wedges for electrical apparatus. The alloy contains iron, nickel, chromium, and small amounts of molybdenum, titanium, and manganese. It is available

in forged, rough-turned billets up to 10 inches in diameter; upset pancake forgings weighing a maximum of 1000 pounds; round centerless-ground bars in all sizes; cold-rolled strips in continuous lengths 18 inches wide or less, in thicknesses from 0.005 to 0.090 inches; and in plates from 1/8 to 3 inches thick, up to 18 inches wide.

W-545 forges well between temperatures of 1700 and 2100 degrees F. Its mechanical properties are generally influenced by the final amount of reduction and the final finishing temperature. A substantial increase in yield strength is obtained when the finished forging temperature is below 1800 degrees F. It can be machined with type C-2, C-5, or C-6 tungsten-carbide cutting tools.

Self-Tapping, Nylon Stop Nuts that Lock, Seal, and Insulate

A self-tapping, hexagonal nut with locking and sealing features, called the "Brilok Nylon Stop Nut," which has been molded to American Standard dimensions and permits the use of conventional installation and removal tools, is introduced by Byrd Plastics, Inc., 2953 W. 12 St., Erie, Pa. In use, the nuts extrude into the clearance spaces of the thread of the screw, forming a seal against liquid or gas escape, or the entrance of corrosive influences. They are available in the following standard sizes: Nos. 4, 6, 8, and 10, and 1/4, 5/16, 3/8, and 1/2 inch. Besides the self-tapping design, nuts may also be obtained in either half or fully tapped form.

High-Strength Impact-Resistant Plate for Low Temperatures

An alloy plate with high impact resistance and high strength at temperatures as low as —320 degrees F. is being produced by Lukens Steel Co., Coatesville, Pa. "Lukens Nine Nickel" plate, as it is called, has a minimum tensile strength of 90,000 psi and a minimum yield strength of 60,000 psi. It can be welded by using established techniques and available electrodes.

Tungsten-Carbide Coating with a 98 Rockwell A Hardness

A tungsten-carbide coating material produced by Walmet Corporation, 29900 John R, Madison Heights, Detroit, Mich., is marketed under the name of "Spra-Carb." The use of this material provides a working surface hardness of approximately 98 Rockwell A. The coating, which is a hard, tough layer of tungsten-carbide particles bonded with nickel, chromium, and boron, provides a tough, strong, and highly wear-resistant surface. It can be machined with a good, hard grade of tungsten carbide and may be ground with a green silicon wheel for rough- or finish-grinding, and a diamond wheel for very smooth finishes. About 0.010-inch extra stock is sprayed on the surface for finishing purposes. The thickness of the finished coated surface usually ranges from 0.010 inch to 0.062 inch.

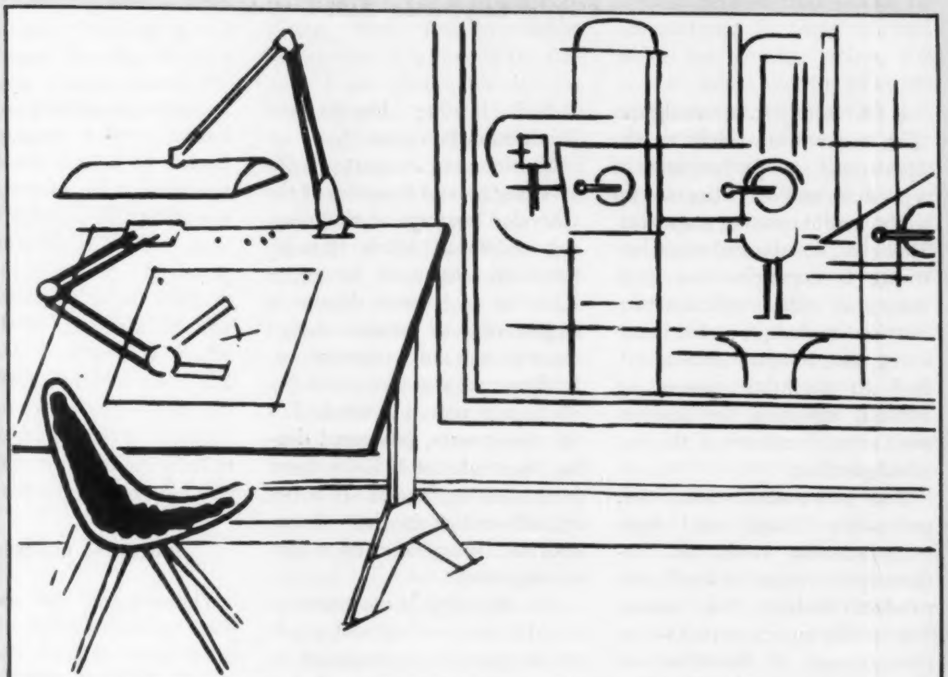
Acid-Resisting, Insulating, and Refractory Material of Pure Silica

An acid-resistant, insulating, and refractory material that is made of 99 per cent pure, fused silica which will neither oxidize nor absorb moisture is presented by Pittsburgh Corning Corporation, 1 Gateway Center, Pittsburgh 22, Pa. This material, which is called "Foamsil," is unaffected by all acids with the exception of hydrofluoric and hot phosphoric. It withstands thermal shock within the range of —450 degrees F. to plus 2200 degrees F. The material is a lightweight, rigid, inorganic block with a closed-cell structure that is made from pure silica activated by a foaming agent. It has good dimensional stability and does not warp, shrink, or slump during rapid temperature changes.

Some of its other properties are: a coefficient of expansion of 3.5×10^{-7}, a compressive strength of 130 to 210 pounds per square inch, and a density of 10 to 12 pounds per cubic foot. The material may be used as a lining inside tanks, pipe lines, dipping vats, electric and heat-treating furnaces, and as flues for conducting acids, gases, and fumes. It is available in block sizes, 11 inches by 17 inches and 17 inches by 22 inches, in thicknesses up to 3 inches.

This refractory and insulating material made of 99 per cent silica does not absorb moisture and may be readily cut and shaped with knives or saws.

MACHINERY'S Reference Section



WHAT THE DESIGNER SHOULD KNOW ABOUT PRODUCTION

September 1958

What the Designer Should Know About Production

KENNETH C. BUTTERFIELD
Director of Manufacturing Engineering
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ALL too often, designers concentrate solely on the appearance and performance of a product, and leave the cost up to the manufacturing engineers. However, economical manufacturing is dependent on good design as well as efficient production techniques. In many cases, part designs can be modified to facilitate processing without affecting the appearance or performance of the finished product.

Tool construction difficulties, processing "bugs," and high manufacturing costs can frequently be traced to inefficient product design. This truism was vividly demonstrated to the management of the Chrysler Corporation recently when the company undertook the most extensive and expensive tooling program in its history. Approximately $300 million were expended, thousands of tools were constructed, and more than 3400 dies were necessary.

In any program so comprehensive, tooling bugs and production bottlenecks are sure to be encountered. However, in this particular program, the cost of correcting such difficulties was felt to be excessive. Too many of them were directly attributable, in varying degrees, to product design. In an effort to eliminate these troubles and to reduce the cost of future tooling programs, the Chrysler Corporation has initiated a training course that is called "Product Design and Production Processes."

This course is part of the Evening School Program at the Chrysler Institute of Engineering in Detroit, Mich. It is offered to engineers having a Bachelor of Science degree in engineering or product-design experience, and requires attendance at eighteen class periods, one period a week. For the first course, presented during the winter of 1957-58, there were sixty registrants. It is being offered again this winter, and will be repeated on a continuing basis.

The objective of the course is to aid those involved with product design and development in obtaining a greater knowledge of production processes, and to understand the critical interrelationship of these processes with design. All major production processes used in the automotive industry are covered, and the instructor for each process is a manufacturing specialist in his particular field.

As each process is discussed, specific examples (based on the company's own manufacturing experience) are presented to show the "before" and "after" designs and their effect on tooling and production. The instructor indicates how certain design features can be developed which will permit improved manufacturing. For example, he may point out why a specific radius is too small, why a particular casting breaks too easily, why a certain surface cannot be held to the tolerance specified, why assemblies will not always go together the same way, etc. It is constantly emphasized, however, that the manufacturing aspects should not be stressed to the point where styling and design are adversely affected. Rather, it is the aim—when two or more possibilities of design are evident—to help the designer choose the one best for production.

Processing Equipment

Determining the most efficient processing for a part is made more difficult by having so many types, sizes, and capacities of machines available to do the same kind of work. As a result, it is impossible to supply the product designer with specific details covering the machines that will be used to produce a designed part. However, general information of this sort should be provided by his plant, and the designer should be kept informed of the latest acquisitions in processing equipment—particularly of machines that will permit him greater flexibility in his work.

One of the greatest needs in industry today is for more standardization—particularly in the capacity of a particular type of machine to do work. Standardization can be facilitated—and the results from mass pro-

duction techniques, improved—by grouping together similar or identical items of manufacturing equipment. This procedure also permits the development of special skills in people best fitted for the work at hand, and has been carried out at Chrysler Corporation by grouping together basic manufacturing units such as the Forge & Foundry Division, Engine Division, Stamping Division, Axle & Transmission Division, Parts & Equipment Manufacturing Division, and Electrical Equipment Division.

Effect of Product on Tool Design

One of the most critical effects of the product on tool design is the requirement for dimensional tolerances. Those specified frequently determine the type of processing required, and close tolerances generally necessitate the use of a more elaborate and expensive machine. A good example of this situation occurred recently. When a tolerance of 0.0005 inch was specified for a part used on the power-steering pump, it was necessary to pay several thousand dollars more for a machine than would have been required if a 0.001-inch tolerance were allowed.

The specification of closer tolerances on a part usually necessitates a more elaborate tool design. For example, in zinc die-casting, a tolerance of plus or minus 0.001 inch can generally be held between surfaces formed by integral parts of the die. However, if the measurement is across a parting line or moving members of the die, a few more thousandths of an inch must be added to the tolerance. The designer of the casting should visualize how it will be made and select, if possible, a tolerance that will assist, rather than hinder, the tool design. The necessity for every tolerance should be carefully weighed before assigning it to a part dimension.

Another factor influencing tool design is the surface finish specified for the part. The actual function of the part should dictate the minimum finish, and this, in turn, will permit maximum production at the lowest possible cost. The optimum condition, from the production standpoint, is to specify the surface finish obtainable by the basic manufacturing method to be used. Also, the relationship between dimensional tolerances and surface finishes should be considered—not, as has happened, to specify close tolerances on the dimensions between rough surfaces.

Accessibility for machining, processing, and assembly is another important factor in which product design affects tool design. Internal grooves or recesses, for example, are bad from the manufacturing standpoint. Castings that have to be thoroughly cleaned internally should be carefully studied to insure accessibility of the cleaning medium.

Standardization is as important to successful and economical tooling as it is to processing equipment. It is advantageous to be able to use repetitively such standards as the sizes and locations of guide pins in dies, retainers for piercing punches, sprue sizes for master mold patterns, heights for unloading, and minimum spacing for spotwelds. Variations from such standards cause increased tool costs and create the need for carrying special tools.

Inspection Problems

Inspection is an important function in the successful manufacture of any product. Since there are so many chances of error during the conversion of raw material into a finished part, the gaging points must be established early in the design. Where holes or surfaces are not available for use as check points, special provisions should be made. For example, tabs might be provided on stampings for use in locating during manufacture, and then removed prior to assembly.

Considerable trouble can be encountered in using pierced holes for gaging, unless the hole is placed over the pilot pin in the same axial direction that the hole was pierced. A hole shown round on the design drawing of a formed stamping may require the use of an expensive, developed-shape punch, since the metal will be pierced at an angle to the surface. Then, if the hole is used for gaging and the pilot pin is at an angle other than that at which the hole was pierced, trouble results. Such cases should be resolved by first having the manufacturing people decide the angle at which they want to pierce and gage, and then by asking the design engineers to accept whatever developed-shape hole a round punch will make.

Highlights of the various subjects covered in the Chrysler course "Product Design and Production Processes" will be published in MACHINERY as a series of Reference Sections. While most of the information will seem elementary to experienced process engineers, it should be remembered that the material is directed to men involved with design and development. Even so, the articles should be of considerable interest to younger production people, tool engineers, and students, as well as a valuable refresher course for more experienced men. The first article, on the subject of plastic materials and processing, is included in this Reference Section.

What the designer should know about production — Part I

PLASTIC MATERIALS and PROCESSING

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EARLY EXPERIENCES with the use of plastics in the automotive industry were discouraging. Cracked steering wheels and instrument panels, warped door knobs, and similar troubles were common. These early failures were the result of the lack of standardization of raw materials, the unavailability of sufficient physical data, and misapplication.

However, during World War II, the Armed Forces set up strict criteria for plastic materials to be used for military purposes. Also, plastic suppliers organized among themselves to exchange information and establish standards. These developments led to improved materials and their wider application. Included among the automotive applications of plastics are interior door-trim panels, cushion inserts and backs, floor carpeting, heater housings, and paneling.

Basically, all plastics fall into either of two categories—thermosetting or thermoplastic. Thermosetting compounds may be compared with concrete. In plastics, the binder, or "cement," is a chemically produced resin resulting from a partial union of phenol and formaldehyde. This resin is mixed with a filler such as powdered wood, asbestos, cotton fabric, or mica, depending on the properties required. The combination of heat and pressure on the compound causes it to become plastic. Continued heat and pressure complete the chemical union of the phenol and formaldehyde. The filler particles are bonded into a unit mass incapable of being softened again by heat, which now resists chemicals that would have dissolved the resin before it had passed the thermosetting reaction in the mold. Other thermosetting materials include urea-formaldehyde, melamine-formaldehyde, silicone resins, and polyesters.

Thermoplastic material can be compared to sealing wax in that it is a dense, hard substance at room temperatures. When it is heated, it becomes soft and pliable and can be molded. When it cools again to normal temperatures, it returns to its original density and hardness. Unlike thermosetting resins, the thermoplastic material may undergo this softening-by-heating and hardening-by-cooling process again and again. Since there has been no chemical change in the material during the heating and cooling cycle of molding, the same chemicals which would attack it before molding will still attack it afterward. Examples of thermoplastic materials are cellulose acetate butyrate, ethyl cellulose, acrylics, vinyls, polystyrene, nylon, polyethylene, and epoxies.

There are four common techniques employed for molding plastics: injection, compression,

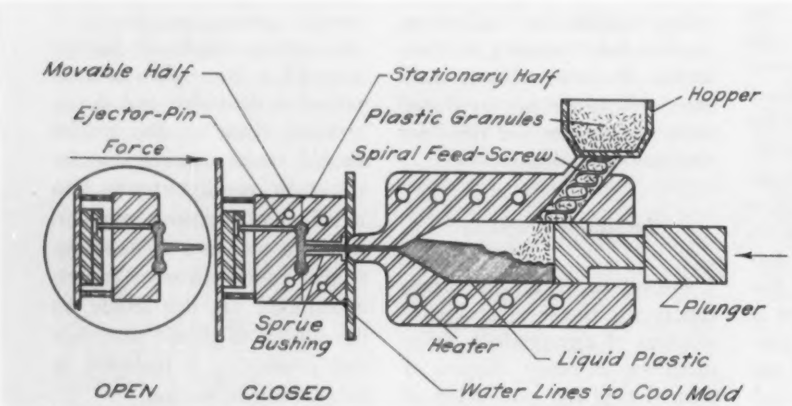


Fig. 1. In injection molding, plastic is fed into heated cylinder and forced through nozzle into a closed mold.

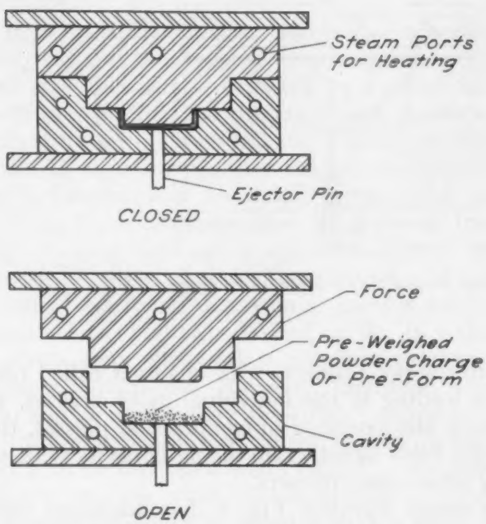


Fig. 2. Closed and open positions of a compression mold for plastics. This type molding is employed for thermosetting materials.

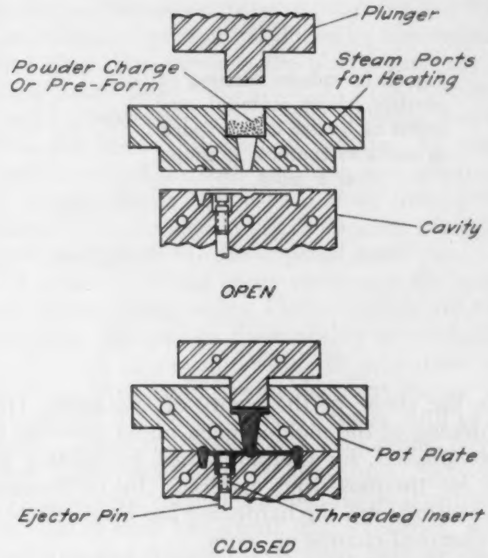


Fig. 3. Plastic material is preheated dielectrically or by steam for transfer molding. Close-tolerance parts can be produced.

transfer, and vacuum molding. There are other types of molding which are adaptations of these four techniques; for example, post-forming, bag-forming, and drawing.

Injection molding is generally used for thermoplastics in making parts such as toys and novelties. Most of the principles of injection molding have been borrowed from the older art of die-casting. As seen in Fig. 1, granular molding material is fed into one end of a heated cylinder. Here it is heated and softened, and is pushed out of the other end of the cylinder into a relatively cool, closed mold. Here the material hardens, and is then removed.

In order to provide time for the heating of each successive charge of the plastic, the cylinder is designed with the necessary capacity and length to hold a number of charges. The exact capacity depends on the size of the article to be produced. The cylinder is kept filled by metering the feed, either by volume or weight, to balance exactly the delivery of softened material into the mold. Thus, at all times the cylinder contains a number of successive charges in progress from the cold-feed end, through the heating zones to the delivery end.

Within the cylinder, at the approach to the delivery end, a spreader or "torpedo" is provided to divert the material into constricted channels where it may be more uniformly heated and softened. Also, the delivery end of the cylinder is fitted with a nozzle containing a small orifice, which during injection fits tightly against a bushing to give entry into the closed mold. This opening into the mold is known as the sprue. In a single-cavity mold, the sprue delivers the plastic through a constriction, termed the gate, into the mold cavity. In multiple-cavity molds, intermediate channels, known as runners, carry the material from the sprue to the gates of the cavities.

Both thermosetting and thermoplastic materials can be molded by compression. However, thermoplastics can generally be molded more economically by injection, and as a result, compression molding is usually confined to thermosetting materials. Compression molding consists of loading the material into an open, heated mold, shaping it by closing the mold under pressure, and hardening it in the mold under pressure. The process is illustrated diagrammatically in Fig. 2.

In modern plastics practice, the molding material is supplied in either pulverized, preformed, or laminated form, depending upon the finished piece. The softening of the material by heat in the mold serves to permit the pressure to weld it into a continuous mass, and to force this mass to

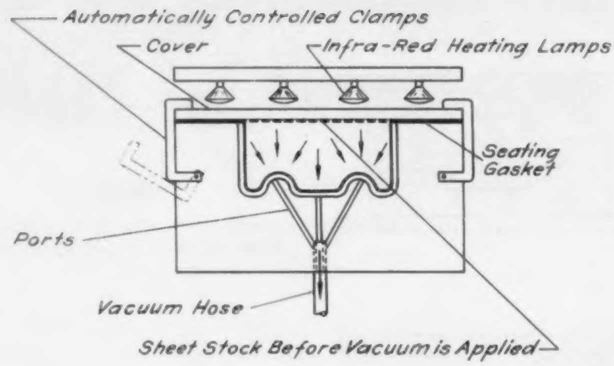


Fig. 4. In vacuum forming of plastics, sheet material can either be formed in free space or made to conform to shape of a mold.

take the shape of the cavity of the mold. The hardening of the molded mass under pressure is accomplished, for thermoplastics, by cooling it, and for thermosetting materials, by continuing the heating until the hardening has been effected by chemical change or "cure."

Transfer molding is used to produce parts where close tolerances are needed, or where metal inserts are required, as in the case of automotive engine distributor caps. In transfer molding of either the pot or plunger type, the material (usually preformed and preheated dielectrically or by steam) is introduced in a softened, semi-plastic state into a chamber called a pot, or well, which is separate from the mold cavity. From this pot, the material is forced by pressure through one or more orifices into the heated mold cavity or cavities, as seen in Fig. 3.

In certain pot type transfer molds, intended for operation in compression presses, the orifice from the pot connects with channels called runners leading to the individual mold cavities. In others, also operated in compression presses, the orifice leads directly into the mold cavity without any intervening runners.

Vacuum forming, Fig. 4, has advanced considerably in the last few years due to the flexibility of new types of materials. Some of the automotive parts presently produced by vacuum forming are seat side-shields, headliners, and radio cabinets. Either vacuum or air at above atmospheric pressure may be used to produce desired differentials of pressure. The sheet material may either be formed in free space or be made to conform to the shape of a mold. The choice between vacuum and air under pressure will depend upon many factors which include shape of the article, the optical quality desired, the maximum forming pressure required, and accuracy of conformance to contours of the mold.

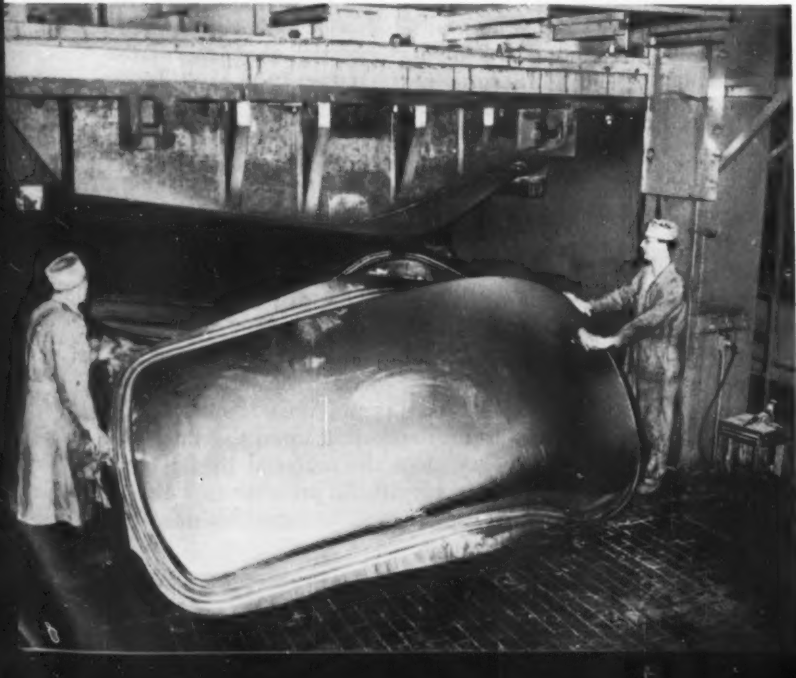


Fig. 5. Large plastic die for drawing roof panels of Crown Imperial limousines is made in three pieces and weighs approximately 13 tons.

The maximum pressure differential available with vacuum is 14.5 psi, and, in practice, a maximum of 10 to 13 psi is generally used with vacuum methods.

It is up to the process engineer, the product designer, and the stylist to decide which process and type of material can best be applied for a particular product. At the Chrysler Corporation, very little injection or transfer molding is being done. Most of our plastic work is in the laminating and tooling end, for dies, fixtures, models, etc.

Many types of plastic dies—for drawing, forming, flanging, and other operations—have been produced by the Chrysler Corporation, and technicians have found that each requires a different approach to obtain the desired results. In making a plastic draw die, work is usually done directly from the die model. However, prototype panels can also be used if they are suitably supported to withstand a pressure of 20 psi. Assuming that a die is to be built to a wood model, a wooden or plaster ring line would be established. Then, the entire model would be boxed in so that the model forms the base of the box. All surfaces would then be coated with a mold release agent such as paste wax. The volume of the die is then estimated so that the proper proportions of chopped fiber, cloth, and resin can be weighed out.

The polyester resin to be used for the entire die is all mixed at the same time, using cobalt naphthanate and MEK peroxide as the curing agents. The face of the die is then laid up with cloth and resin by cutting the cloth into patches suitable for easy presaturation with resin. The box is filled with 2-inch long chopped fibers, presaturated 50 per cent with resin, and the entire lay-up is covered with a wooden plug which just fits inside the box. The plug is then forced into the box under a constant pressure of 20 psi until the resin cures. Through the use of pressure while the dies are going through the gel stage, shrinkage can be controlled, and the die can be cast true to form. Once one section is made up, the successive sections are cast to it.

In cases where extreme conditions of wear are encountered, such as sharp corners or deep draws, metal inserts are prefitted to the model and cast into the die face. Metal can also be added to the die after it has been completed. The sections are placed in an oven, maintained at a temperature of 200 degrees F., for a short period, in order to insure a complete cure.

For limited production runs, the plastic die cannot be beaten. The cost of making it, divided by the number of stampings it produces, is a fraction of the cost per unit produced by conventional steel dies. Also, because the plastic dies can be made much faster and from 30 to 60 per cent cheaper, more frequent model changes can be made for limited production vehicles. An excellent example of the cost- and time-saving features of plastic dies is the large 13-ton, three-piece, plastic draw die seen in Fig. 5. This die is used to draw roof panels for the Imperial limousine.

A major use of the epoxy resins is in the model and fixture departments. Plastic models are very desirable because of their ability to withstand hard usage. It is even possible to store them out-of-doors, thus saving valuable plant space. The model and fixture surfaces are made with epoxy resins, while the cubes and supporting framework are principally of preshrunk, polyester Fiberglas construction. Epoxies are used primarily because of their low-shrink characteristics, while the polyester framework is used because of its relative ease of fabrication, higher heat distortion, and lower material cost.

As an illustration, it can be assumed that a duplicate roof-die model is to be constructed where "break-away" models are required. The original mahogany model is first waxed and set up on a surface plate. Careful planning is required to insure that all undercuts in the female

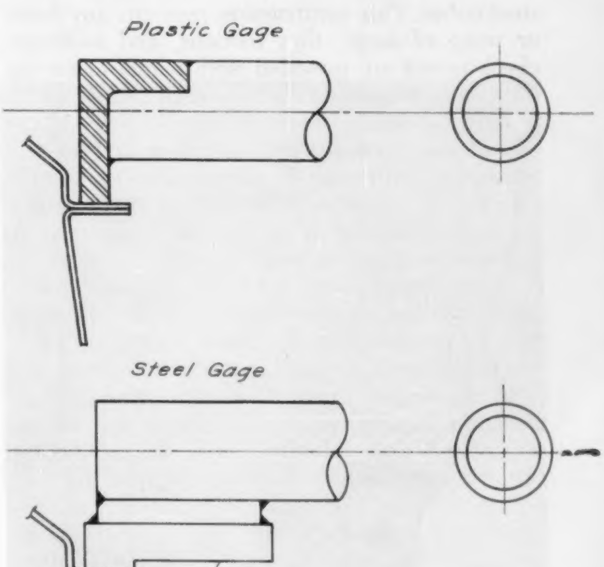


Fig. 6. Weight of plastic gage (top) is approximately 20 per cent that of steel gage (bottom). Also, no welding is required with plastic, since it is bonded as a unit.

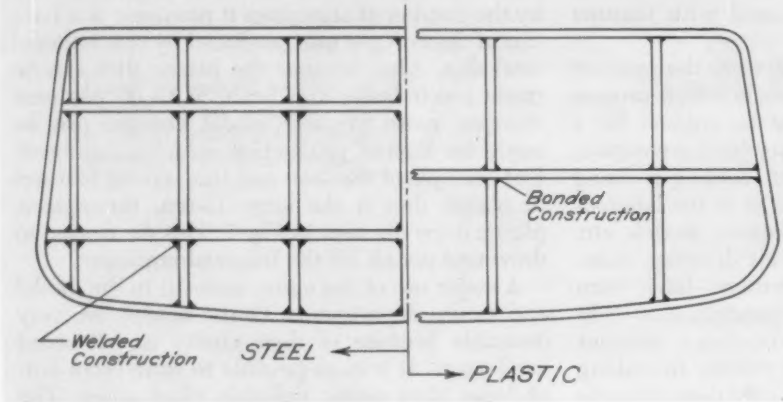


Fig. 7. Weight of plastic fixture (right) for checking automotive body windshield openings is 80 per cent less than the steel fixture at left, thus simplifying its use in production. More supports are needed on the steel fixture because of its weight.

cast can be removed by a piece mold method from the model. All undercuts are set to angle plates, and are laid up separately with epoxy resin and glass cloth until the lay-up reaches the angle plate surface, which squares up the undercut to the surface plate regardless of contour. This will be a check point which can be used for checking the plastic model.

After all undercuts are so treated, the surface of the model and undercut cast is carefully coated. On this prepared surface, a balanced lay-up is made with a cool-setting, epoxy type resin and Fiberglas cloth to a thickness of approximately 1/2 inch. A cube of preshrunk reinforced polyester tubing is constructed over the lay-up, and cast to the previously set up angle plates or steel cubes. This construction prevents any twist or warp of large, thin sections, and sufficient check points are provided with which to set up the cast in preparation for the final lay-up which produces a duplicate model.

Undercut cast sections are dowelled to the major cast with press-fit dowel pins. The duplicate model should now be laid up in a manner similar to that used in making the female cast. A separate construction is made of the model cube from reinforced plastic tubing, and assembled to the plastic model with screws and dowels, or it may be permanently cemented with glass cloth and epoxy resin, depending on the requirements.

Since assembly fixtures require rough handling, checking fixtures require a high degree of accuracy and close tolerance, and drilling and locating fixtures require both rough handling and accuracy, varied materials and techniques are required in the manufacture of plastic fixtures. They are laid up in much the same manner as dies. However, because of their application, a high glass content is required for fixtures. Not only does such construction permit considerable abuse without damage in production, but it gives the added strength needed to hold screws, dowels, and press-fit bushings. Checking and spotting fixtures require a much better contacting surface and a greater degree of accuracy. This is accomplished by the use of a very low-shrink resin. A comparison between plastic and steel gages and checking fixtures is illustrated in Figs. 6 and 7. The cost of the plastic checking fixture, Fig. 7, is less than 70 per cent that of the steel fixture.

In addition to being lighter than steel, and easier to handle due to one-piece construction, plastic fixtures have another highly desirable feature. Much of the layout necessary in their steel counterparts is eliminated by a plastic prototype skin made directly over the model. The skin, which is transparent, reproduces the layout—such as station lines, reference points, hole locations, etc. Thus, layout is simply a matter of copying.

An outstanding use for plastic dies has been found in the production of panels for pilot models, and also for production models, where permanent tooling is not yet completed. In order to save time and money, plastic dies are being used to ascertain various draw-die conditions, and the feasibility of making a part by various operations before the actual steel-die construction is started.

The importance of plastic in industry is still growing rapidly. In the year 1956, almost four billion pounds of plastic were used in the United States alone, which is an increase of almost 50 per cent in the last five years. The Chrysler Corporation is convinced of the value of plastic tooling and is pursuing its own investigations of possible new applications. With the many ideas, new materials, and tests now in process, there should be an even greater expansion of the use of plastics in the near future.

MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

Curvature Produced by Grinding or Milling Using a Tilted Spindle

M. BARASH

"Heel drag" in surface grinding and face-milling operations can be avoided by tilting the cutter-spindle slightly in the direction of travel. This spindle tilt will, however, affect the flatness of the surface produced, making it slightly concave. It is of interest to determine not only the amount the resulting surface will deviate from perfectly flat but also how this method can be used intentionally to generate concave surfaces. The problem, in either case, is one of determining the relation between the tool diameter (grinding wheel or milling cutter), the angle of spindle tilt, and the resulting radius of curvature of the surface.

Solution:

Fig. 1 shows the geometric relation between the work-piece and a cutter tilted at some angle α with the direction of cutter or work travel. As the cutter traverses the length of the work-piece, its periphery will generate a concave surface. The depth of the concavity h is related to the mean radius of curvature R of the surface and the width B of the work-piece, as shown in the left-hand diagram of Fig. 1. The mathematical relation between R, B, and h is, by the Pythagorean Theorem,

$$R^2 = (R-h)^2 + \left(\frac{B}{2}\right)^2 = R^2 + h^2 - 2Rh + \frac{B^2}{4}$$

so that $2Rh = \frac{B^2}{4} + h^2$.

Since h is small compared to R and B, the h^2 term can be neglected. Then,

$$2Rh = \frac{B^2}{4}$$

$$R = \frac{B^2}{8h} \qquad (1)$$

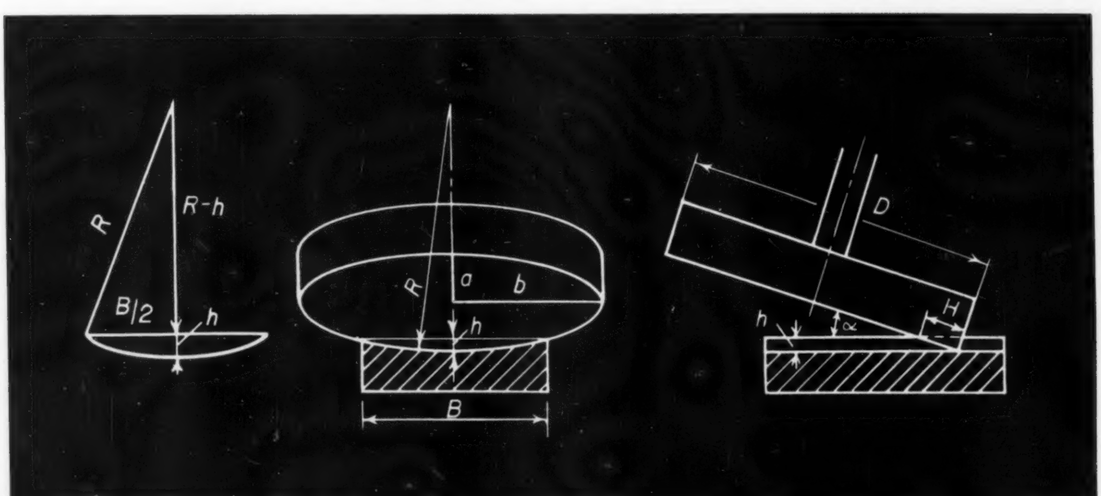


Fig. 1. Geometric relation between work-piece and cutter when cutter-spindle is tilted at angle α.

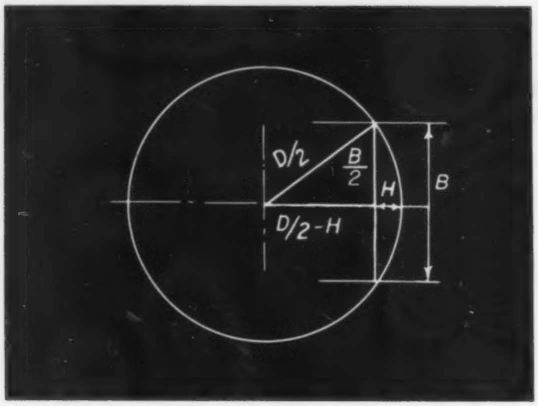


Fig. 2. Plan view of cutter from which (H) may be calculated.

From the right-hand diagram in Fig. 1, it may be seen that the relation between h, α, and the radial distance H on the cutter is:

$$h = H \sin \alpha$$

Substituting this value in (1),

$$R = \frac{B^2}{8H \sin \alpha} \qquad (2)$$

Fig. 2 is a view of the plane of the lower face of the cutter. From this diagram,

$$\left(\frac{D}{2}\right)^2 = \left(\frac{B}{2}\right)^2 + \left(\frac{D}{2} - H\right)^2$$

Simplifying,

$$H^2 - DH + \frac{B^2}{4} = 0$$

Solving for H using the quadratic formula,

$$H = \frac{D \pm \sqrt{D^2 - B^2}}{2}$$

Since $H \leqq \frac{B}{2}$ the plus sign before the square root term may be dropped so that

$$H = \frac{D - \sqrt{D^2 - B^2}}{2}$$

$$= \frac{D\,(1 - \sqrt{1 - (B/D)^2})}{2} \qquad (3)$$

Substituting H from (3) in (2),

$$R = \frac{B^2}{4 \sin \alpha\, D\,(1 - \sqrt{1 - (B/D)^2})}$$

$$= \frac{(B/D)^2}{2\,(1 - \sqrt{1 - (B/D)^2})} \times \frac{D}{2 \sin \alpha} = k\,\frac{D}{2 \sin \alpha} \qquad (4)$$

As may be seen in the center diagram of Fig. 1, the projection of the circumference of the cutter is an ellipse so that, correspondingly, the concave surface generated on the work-piece will be a portion of an elliptical cylinder having semi-minor and semi-major axes of a and b, respectively. The radius of curvature at the bottom of the cavity, therefore, is that given by the standard equation for the radius of curvature R' at the apex of an ellipse:

$$R' = \frac{b^2}{a}$$

As may be seen from Fig. 1, $a = D/2 \sin \alpha$ and $b = D/2$ so that, by substitution,

$$R' = \frac{D}{2 \sin \alpha} \qquad (5)$$

Comparison of (4) and (5) shows that the relation between the average radius of curvature R of the cavity and the radius R' at the bottom of the cavity is $R = kR'$, the value of k depending on the ratio B/D as seen in (4). Values of k for various ratios B/D are given in the accompanying table.

Values of k for Various Ratios of B/D

B/D	0.2	0.4	0.6	0.8	0.9	1
k	1	0.97	0.9	0.8	0.71	0.5

From this table it is seen that for work-piece widths B that are less than or equal to one-half the cutter diameter D the mean radius produced by tilting the cutter-spindle is practically equal to the value given by (5).

A Less Elegant Solution of June's Problem

A simple solution of the problem in eccentric turning solved in the June issue of MACHINERY has been submitted by W. W. Johnson of Cleveland, Ohio.

Referring to Example 1 (see page 159, June MACHINERY), by the law of sines,

$$\frac{r}{\sin 60^\circ} = \frac{e}{\sin \alpha}$$

$$\sin \alpha = \frac{e \sin 60^\circ}{r} = \frac{0.2 \times 0.86603}{1} = 0.173206$$

$$\alpha = 9^\circ 58' 27''$$

$$\phi = 180^\circ - (60^\circ + \alpha) = 180^\circ - 69^\circ 58' 27''$$

$$= 110^\circ\ 1'\ 33''$$

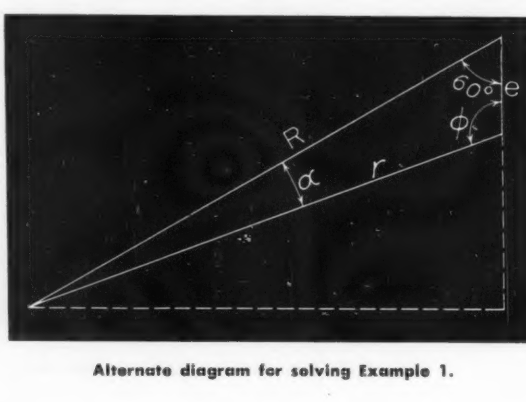
Again, by the law of sines,

$$\frac{R}{\sin \phi} = \frac{r}{\sin 60^\circ}$$

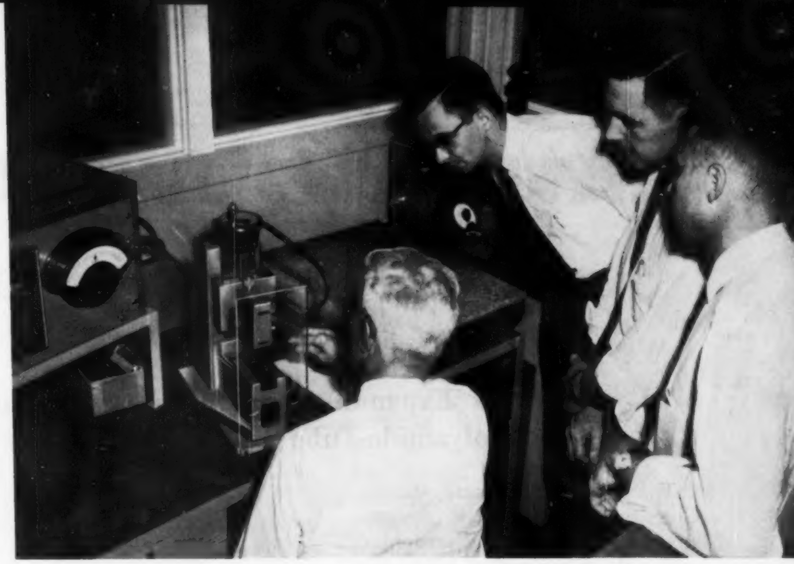
$$R = \frac{r \sin \phi}{\sin 60^\circ} = \frac{1 \times \sin 110^\circ 1' 33''}{\sin 60^\circ} = 1.0849$$

Then,

$$x = R + e - r = 1.0849 + 0.2 - 1 = 0.2849 \text{ inch.}$$



Alternate diagram for solving Example 1.



Work-shop sessions were a part of the product reliability seminar. Here, the precision measurement of gage-blocks on an electronic comparator is being demonstrated. The meter is graduated in 0.000001 of an inch.

Product Reliability is Theme of Seminar

AN INDUSTRY SEMINAR on the subject of "Precision for Product Reliability" was conducted recently by the Federal Products Corporation, Providence, R. I. Lasting for three days, it consisted of conferences and work-shop sessions on design, machining, process control, and gaging directed toward precision in product manufacture and inspection.

Coordinating the seminar was Clifford W. Kennedy, manager of training for Federal Products. Leading into the conference Mr. Kennedy referred to the findings of a past survey conducted by the Massachusetts Institute of Technology, pointing out that inspection costs are lowest at the machine.

The keynote speaker, Professor Theodore H. Brown, Harvard Graduate School of Business Administration, set the stage for ensuing discussions on reliability. He stated that reliability in a mechanism means it will fulfill definite performance specifications, for either a single event or a series of events, with a pre-set probability of success. Continuing on this theme, Earle Buckingham, professor (retired) M.I.T., spoke on the relationship between conditions of size, form, and position, and on various aspects of functional gaging.

An objective view of precision manufacture and inspection was afforded the attendees through discussions by representatives of industry. Among the topics covered were "Machining to Millionths," by Fred J. Underwood, Heald Machine Co.; "Seeing is Believing," by Robert J. Hudak, Eastman Kodak Co.; "The Count-Down to the Millionth," by W. J. Hayes, Link Aviation, Inc.; and "Splitting the Millionths," by J. K. Emery, Van Keuren Co.

Topical discussions were also led by members of the sponsoring company. These included "From Early American to Modern in Gaging," by Clifford W. Kennedy; "Some Do's and Don't's with Indicators," by Arnold Judkins; "One-Half of Nothing," by L. O. Heinold; "The Low-Down on Air Gaging," by Robert Thomas; and "New Watchdogs of Production," by R. A. Souler.

Dwight Cook to Retire from MACHINERY'S Selling Staff

After twenty-one years of active service on MACHINERY'S advertising staff, Dwight Cook, at his own request, will retire December 31 to become a permanent Florida resident. He carries with him the good wishes of all his associates on MACHINERY'S staff and a host of friends in the field.

Mark E. McDonald, formerly an advertising-space representative with Dun & Bradstreet Inc., took over the eastern portion of Mr. Cook's territory on July 1. This includes parts of New York and Pennsylvania, and all of New Jersey, Maryland, Delaware and Virginia.

Robert J. Lick has been appointed to succeed Mr. Cook in the Ohio-western Pennsylvania territory. Mr. Lick comes with the highest recommendation from a well-known business publishing concern. Bringing as he does five years of experience in business space selling in the same geographical area, MACHINERY feels confident that the interests of our advertisers will be competently served.

LATEST DEVELOPMENTS

Machine Tools, unit mechanisms, machine parts and

Grotnes Expanding and Shrinking Machines Equipped with Polyamide-Tube High-Pressure Lubrication System

The Grotnes Machine Works, Chicago, Ill., recently demonstrated an expanding machine with a draw-bar pull of 1580 tons, said to be the largest and most powerful of its kind. This equipment, shown in Fig. 2, has the power to expand 60 square inches of metal having a yield strength of 46,000 psi. Twenty-four jaws arranged as shown diagrammatically in the view at the left, Fig. 1, are expanded by a downward movement of the draw-bar (see Fig. 4). The draw-bar is actuated by a cylinder in the base of the machine which operates under a hydraulic oil pressure of 3000 psi.

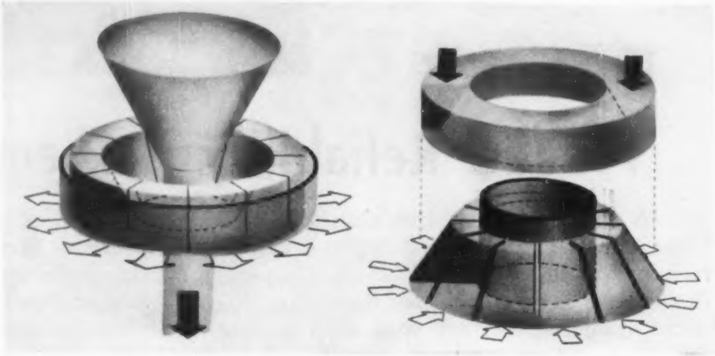


Fig. 1. Diagrams illustrating operating principles of Grotnes expanding and shrinking machines

The maximum length of the work-piece that can be handled on this machine is 28 inches. The jaws have a collapsed diameter of 34 inches and an expanded diameter of 36 inches. The jaws, as shown in Fig. 4, are fittted with die segments. These segments are replaceable and can be machined to the desired finish, form, and internal diameter of the part to be processed.

The work handled by the machine shown in Fig. 2 consists of expanding cylinders of a material having a yield strength of 40,000 psi. One of these parts has an outside diameter of 51 inches, a wall thickness of 2 5/8 inches, a height of 22 1/2 inches, and weighs 3000 pounds. This part is expanded and sized to within plus or minus 0.010 inch of a true circle. The expanding process is claimed to be the most economical means of forming and/or sizing a wide range of parts having a continuous cross-section—either round, square, oval, or polygonal—utilizing materials such as mild steel, alloy steel, stainless steel, titanium, and aluminum. Expanding can be applied to sub-assemblies to eliminate distortions resulting from the assembly process (components joined by bolting or welding, for example). In addition, very heavy sections such as forged or flash-butt-welded gear blanks, jet-engine rings, hydraulic cylinders, and motor frames can be expanded to rough size, thereby eliminating considerable machining time and material waste.

Although expanding is not primarily used for weld testing, the expansion process automatically checks the strength of a weld. Actually, this process is being used extensively for testing welded joints. This has resulted in the improvement of properties of both the weld and adjacent metal. The basic principle utilized in cone type expanders is that of the inclined-plane or wedge arrangement, Fig. 1. An actual working machine, such as the one shown in Fig. 2, is, of course, considerably more complicated.

The basic elements common to all expanders are a cone, draw-bar, jaws, table, and power system. The cone (actually a poly-sided, modified frustum of a pyramid) is attached to the draw-bar which is either hydraulically or mechanically actuated. As the cone is drawn down between the jaws, they are forced radially outward at right angles to the direction of cone travel, moving in slots in the table. A part to be expanded is placed over the jaws—or over dies fastened to the jaws—and is formed or sized when the outward movement of the jaws is sufficient to stretch the metal beyond its yield point. After a part has been expanded, the cone is moved upward, permitting the jaws to collapse (return to their initial pre-expanded position) and the part to be removed.

All Grotnes expanders have the feature of interchangeability of draw-bar, cone, jaws, and table, giving one basic machine great flexibility in range of part shapes and sizes that can be handled. The Grotnes shrinking machines, such as the one shown in Fig. 3, perform an operation that is essentially the opposite of expand-

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by Freeman C. Duston

ing in that the jaw members (instead of expanding outward) are forced inward by a tapered ring, as indicated diagrammatically in the view to the right, Fig. 1. Like the expanding operation, shrinking is used for size control as well as for forming.

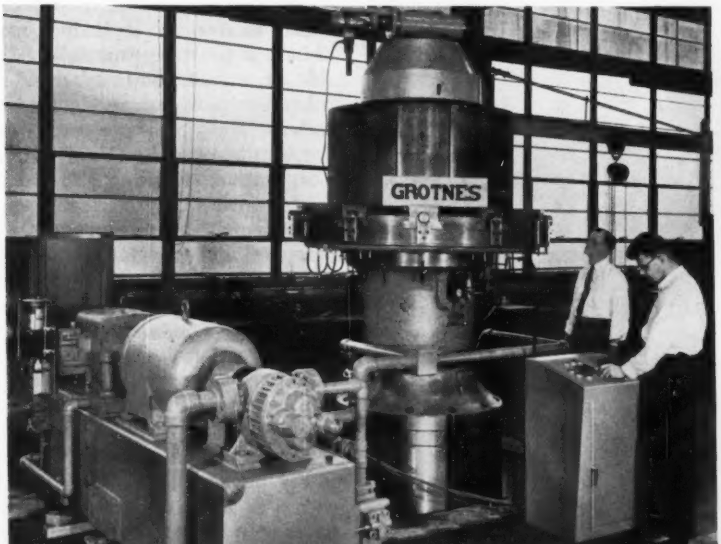
The sizing of parts is performed by means of shrinking instead of by expanding where a higher degree of dimensional accuracy is required. Forming by shrinking is to be preferred over forming by expanding when the area of reduced diameter is relatively small and the requirements as to accuracy of the finished parts are more critical.

By moving the jaw members inward, the gap between jaws or dies is decreased until it disappears. The material is actually shrunk (compressed) so as to effect a reduction either in periphery of the work or, in certain predetermined areas, to obtain precise control of size and shape. The number of jaws to be used is chosen to produce a minimum gap at the start of the operation. Since the jaws are the basic members of the machine on which suitable sizing or forming dies are interchangeably mounted, a given machine can accommodate a wide range of product sizes by simply changing the dies.

If an inward bead or corrugation is desired and the contour of the cross-section were not critical, a simple shrinking operation would be indicated. If, however, the contour were critical (say, within plus or minus 0.004 inch or less), it would be necessary to utilize an internal die or mandrel.

In a typical shrinking operation, heavy domed heads for high-pressure compressed-air tanks are reduced in diameter in a shrinker and in the same operation and at the same time accurately sized so as to perfectly fit the inside diameter of the main cylindrical shell. To carry this further, the shell could also be expanded at each end to obtain a perfect circle and dimensional accuracy so that the resulting final fit between shell and head would be tight.

Since frictional losses are probably greater in a sizing machine than in any other type machine tool, lubrication is a problem of major importance. Although it is practically impossible to determine the exact friction loss, engineers of the Grotnes Machine Works believe they have succeeded in reducing losses 50 to 75 per cent with a polyamide-tube high-pressure lubrication system. Loads on sizing-machine



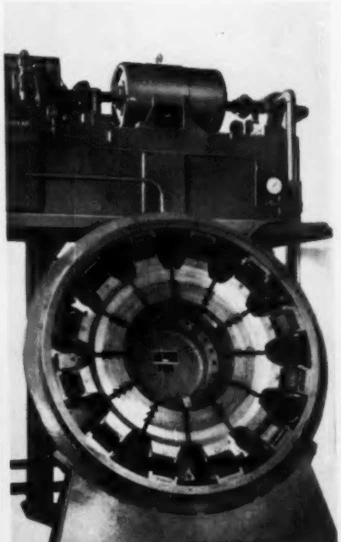


Fig. 2. (Left) Grotnes hydraulically operated expander with draw-bar pull of 1580 tons. Fig. 3. (Right) Shrinking machine built by Grotnes for sizing heavy ring sections

bearings are exceptionally large and so are the friction losses. There are two major friction points: the one between the cone and the work jaws indicated by the heavy black line at *A*, Fig. 4, and one between the work jaws and the support table at *B*. All the draw-bar force—from 25 to more than 1600 tons—is exerted through the inclined contact surfaces of the cone and the work jaws. Force on the latter is applied downward and outward. The outward force component forms the work-piece while the downward component contributes to the friction load between the jaws and the support table.

The combination of high bearing loads, large contact areas, and relatively low sliding velocities presents a difficult lubrication problem. An obvious solution is a high-pressure, automatic lubrication system. However, tubing requirements made it almost impossible to design a compact, rugged system that would be suitable for all machines.

Tubing must withstand 400 to 600 psi internal pressure to supply a metallic-based grease to the sliding surfaces on Grotnes sizing machines, both expanders and shrinkers. Tubing must also be flexible because jaws move several inches at 3 to 10 cycles per minute. Inclined-table expanders, such as shown in Fig. 5, have a requirement all their own: flexible tubing must "stand firm" between fittings, both pressurized and unpressurized. Each machine uses fourteen to thirty pieces of unsupporting tubing from 2 to 4 feet long.

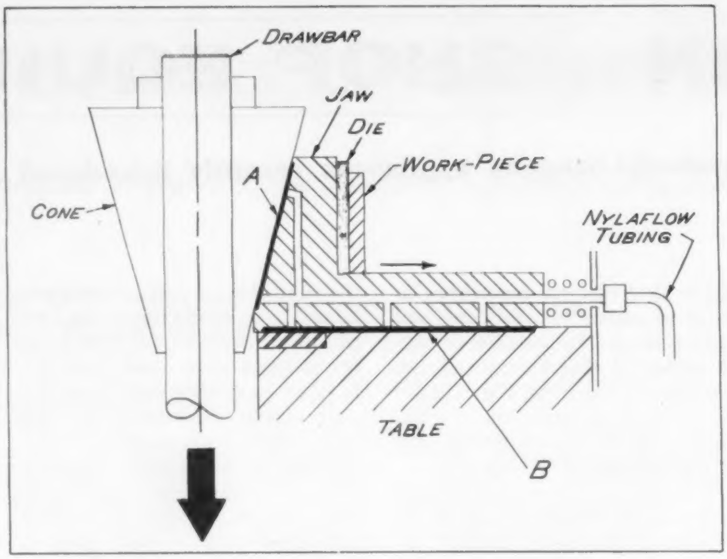


Fig. 4. Section through jaw, die, and work of Grotnes expander showing how "Nylaflow" pressure tubing is used to solve difficult lubricating problem

Shrinking machines, such as shown in Fig. 3, present more of a lubrication problem than do expanders for two reasons: (1) shrinkers use considerably more tubing, and (2) tubing is underneath the table and inside the outer supporting cone. Since there is less space in which to put the extra tubing in shrinking machines, it must be especially flexible, compact, and reliable. A relatively new polyamide tubing called "Nylaflow" pressure tubing, manufactured by the Polymer Corporation, Reading, Pa., was found to meet these exacting requirements. It is inexpensive, compact, and easy to handle and install. The translucent nylon not only presents a neat, clean appearance but also aids in checking lubrication flow. The Type H tubing used for this application has a short-time bursting pressure rating of 2500 psi.

The typical installation shown in Fig. 5 is on a specially designed expander for sizing small-diameter, heavy cross-section, alloy jet-engine rings. On this 215-ton, inclinable table machine, friction losses were cut in half by the installation of the polyamide-tube lubrication system.

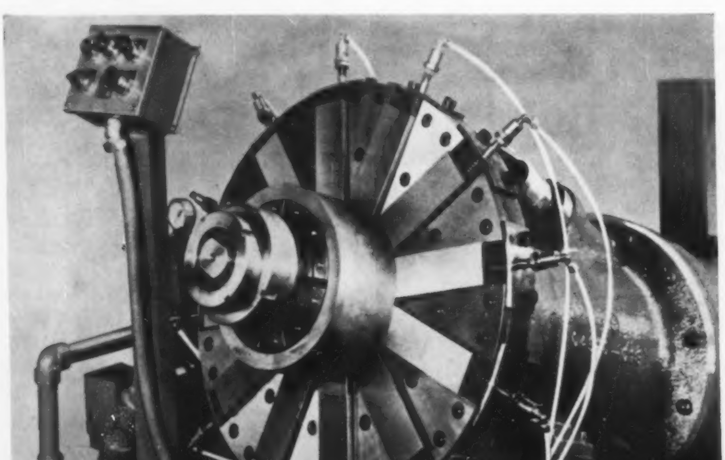
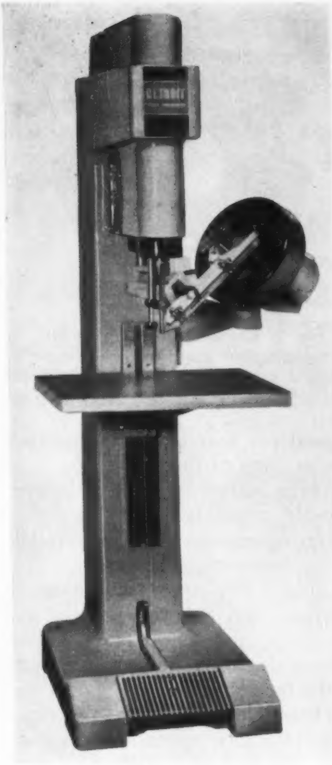


Fig. 5. Grotnes 215-ton, jet-engine ring expander with "Nylaflow" pressure tubing shown unsupported between fittings of high-pressure lubrication system

Circle Item 101 on postcard, page 201



Detroit power screwdriver with magazine feed

Power Screwdriver with Magazine Feed

A Model U, magazine-fed power screwdriver, designed for a high degree of accuracy and flexibility, has been introduced by the Detroit Power Screwdriver Co., Detroit, Mich., subsidiary of Link-Belt Co. Several new components have been incorporated in this screwdriver, such as: a positive-control clutch, hopper-driving mechanism, feed track, and solenoid-operated escapement mechanism. This screwdriver is available as a floor type machine, or without the floor pedestal, as a completely self-contained driving head for use in automatic assembly machines incorporating straightline transfers, etc.

The machine has a driving range of from No. 6 screws, 3/16 inch in length, up to 1/4-inch screws, 1 1/2 inches long. There are no exposed moving parts. The driving motor and belt, pulleys, upper spindle, and clutch assembly are enclosed in a single column with all parts accessible for easy servicing.

The clutch has no friction devices and is unaffected by temperature changes or excessive oil or grease. It is adjustable from a minimum of 15 inch-pounds to a maximum of 120 inch-pounds torque and will maintain its adjustment within a tolerance of plus or minus 2 inch-pounds at the lower range to plus or minus 6 inch-pounds at the higher range, under normal driving conditions.

Circle Item 102 on postcard, page 201

H-P-M Fast-Acting Hydraulic C-Frame Presses

The Hydraulic Press Mfg. Co., a division of Koehring Co., Mount Gilead, Ohio, has brought out a complete line of small, fast-acting, hydraulic C-frame presses built in 5-, 10-, and 15-ton capacities. Two manual and two automatic types are being introduced. All models are designed to JIC recommendations. Manual C-presses are offered for dual-lever, safety-control operation, and with servo-controlled action which permits the operator to apply ram force upon the work at speeds and pressures in direct proportion to the movement of the hand lever.

The basic automatic model provides controls for either single or automatic cycle, and ram reversal controlled by either distance or pressure settings. A positive ram guide is said to assure accurate positioning of the ram so that alignment of tooling is held to close tolerances.

The second automatic model possesses the basic automatic press features as well as control elements for hydraulic interlocking of the index table. The C-press index table has a work circle of 16 inches with either six, eight, or twelve stops for the mounting of tooling, and is designed to carry a full work load of 100 pounds at speeds up to eighty indexes per minute. A smooth ac-

Fast-acting hydraulic C-frame presses built by Hydraulic Press Mfg. Co.

celeration and deceleration barrel-cam principle for indexing the table accurately positions work-carriers beneath the ram within 0.002 inch. The barrel-cam table drive is designed to incorporate an established principle used widely for many types of work-carriers. It provides an accurate and positive drive for the indexing mechanisms. The table may also be manually indexed while tooling or setting up fixtures. Table speed is infinitely controlled by a simple valve located at the operator's fingertips. Ejection cylinders or other tooling elements may be directly mounted on the housing beneath the table dial.

The index table is designed to permit air, electric, or cutting-oil lines to be brought through a hollow spindle in the center of the table when any of these services is required on the dial surface. The dial is sealed from the indexing mechanism to permit the use of cutting oils or coolants at work stations.

This line of presses has ample daylight space to permit tooling for most any type of operation, including forming, drawing, broaching, trimming, staking, embossing, bending, marking, burnishing, crimping, coining, straightening, and assembling.

Circle Item 103 on postcard, page 201

Kingsbury Multiple-Unit Automatic Machine for Processing Aluminum Forgings

Aluminum forgings for air conditioners are processed at the rate of 380 parts an hour on a multiple-spindle, automatic machine built by the Kingsbury Machine Tool Corporation, Keene, N. H. This machine, Fig. 1, has eleven units with thirty-nine spindles which drill, trepan, ream, spot-face, mill, and finish spherical seat of aluminum part, Fig. 2, for air conditioners. The 30-inch index-table of the machine holds eight work fixtures which have been especially designed for manual clamping and unclamping of the work.

Fig. 2. Aluminum forging for air conditioner processed by machine shown in Fig. 1

Seven horizontal units with five-spindle auxiliary heads perform seven operations on five parallel holes—trepanning in three steps, drilling in two steps, combination-reaming and spherical-seating in one step, and combination-finish spherical-seating and chamfering in the final step.

Three vertical units perform close-tolerance operations on one hole. The first unit drills. The sec-

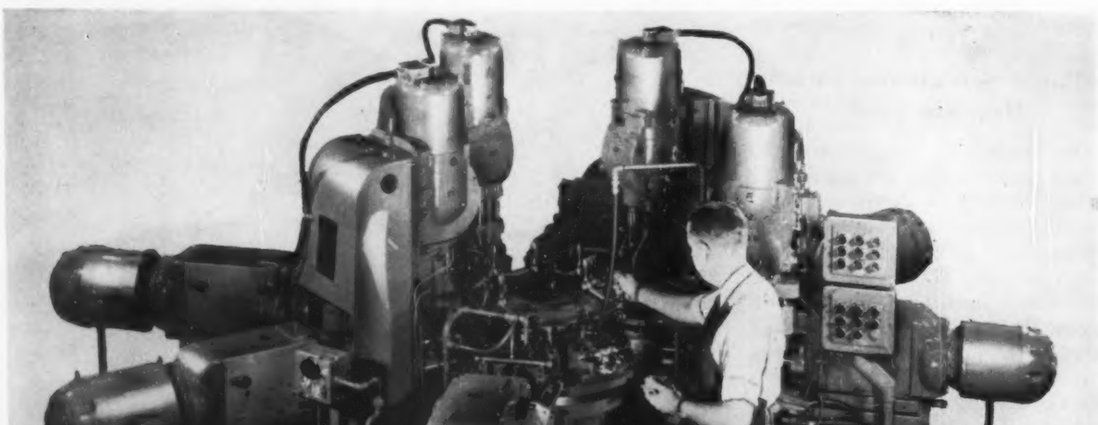


Fig. 1. Multiple-unit automatic machine built by Kingsbury Machine Tool Corporation

ond unit has a combination tool that end reams to make sure the hole is really straight, forms the radius, and faces the boss so that the radius blends into the finished surface. The third unit finish reams.

After these operations have been completed, the operator rechucks the work in a single stationary fixture at his right. The part is clamped automatically, end-milled, and ejected.

Circle Item 104 on postcard, page 201

High-Speed Bench Press

A 7-ton, deep-throat bench press, designed for high-speed punching, cutting, and forming operations on large, wide sheets, is now being manufactured by the E. W. Bliss Co., Canton, Ohio. This press, designated 018-DT, has been designed especially to obtain increased production with a minimum of down time. All parts other than the frame are interchangeable with Bliss bench and inclinable presses of the same tonnage. The standard stroke is 1 1/4 inches but the press is available with a maximum stroke of 2 1/2 inches. The throat depth measures 14 inches.

Features include: a fully stress-relieved frame, rolling-key clutch, extra long gibs which support the slide at all positions, and a heavy-duty crankshaft which is precision forged from SAE 1045 steel. It weighs only 600 pounds, occupying a bench space 27 by 13 1/2 inches and a floor space (with stand) of only 28 by 23 inches.

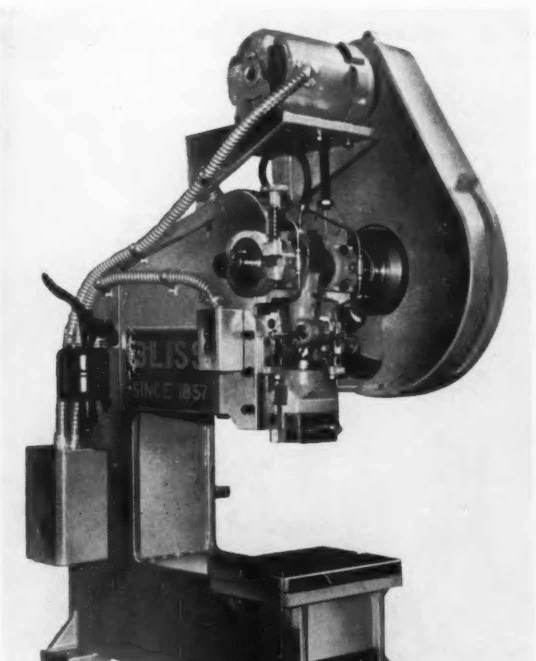
Circle Item 105 on postcard, page 201

Turchan Hydro-Router

A Turchan Hydro-Router equipped with tracing control, stationary table that provides support for large overhanging workpieces, in addition to a completely enclosed power unit, has been introduced by the Turchan Follower Machine Co., Dearborn, Mich. Maximum precision and flexibility are said to be attained by the combination of the Turchan tracer valve and the rigid and accurate adjusting assembly.

The quality of performance of the Hydro-Router depends largely upon the three-dimension tracer valve. This valve is actually three individual, high-precision, four-way metering valves, two of which are mounted in a horizontal plane. All three valves are manifold joined to comprise a single valve actuated by a single stylus. The valve is designed to permit easy disassembly and routine maintenance of any one or all three directional components. The tracing feed rate is infinitely variable.

The Turchan hydraulic power unit used in conjunction with the Hydro-Router has a two-chamber reservoir capacity of 60 gallons with provisions for adequate filtering and settling of the hydraulic oil. The unit features two independent pumps to assure adequate volume when all three saddle and ram movements of the machine are operating simultaneously. This



Bliss high-speed deep-throat bench press

Turchan Hydro-Router with tracing control

method of incorporating two pumps using a single reservoir and motor prevents "starving" one cylinder when tracing rapidly with another cylinder. The hydraulic circuit provides for a separate supply of oil for the vertical movement of the ram and a separate supply for the combined horizontal movements of saddle and ram.

The three-way micrometer adjusting assembly on the Hydro-Router is constructed to more than adequately support the tracer valve. The slides and gibs are hand-scraped and indicator checked before and after installation on the machine.

The adjusting assembly features double-crank, compound-rest type handwheels with large dials readable in 0.001 inch, replaceable bronze nuts for all screw movements, and 5/8-inch diameter Acme thread screws. Adjusting members slide on 5/8-inch deep dovetail ways which are precision machined and hand-scraped. Tapered gibs with positive locks are provided for wear take-up. The tracer valve is easily removable.

Circle Item 106 on postcard, page 201

Ex-Cell-O Precision Boring Machines

Two precision boring machines, incorporating several unique features, have been announced by the Ex-Cell-O Corporation, Detroit, Mich. Designated Styles 711 and 712, these machines serve to extend the line of Ex-Cell-O precision boring equipment previously available. Although these small machines have been primarily developed for the instrument and missile industries, they can be used to advantage whereever the economical production of very small, accurate bores is necessary. Many small gear-cases and similar components requiring accurate holes held to close center distances can be bored in one pass on a high production basis with all the accuracy associated with conventional boring methods.

The Style 712 machine shown in the illustration is equipped with new multiple-spindle head at one end and a standard Ex-Cell-O single-spindle unit at the other. The single-spindle unit may be readily replaced by another multiple-spindle unit if required. Style 711, when supplied with one single-spindle unit only, meets the production requirements for small-hole boring on a vast number of simpler jobs.

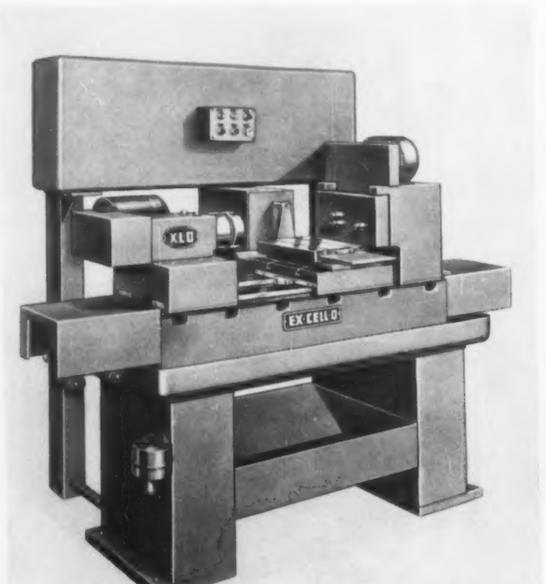
The machine table is operated pneumatically with accurate, hydraulic feed control. A centralized, hand-controlled lubrication system is provided, and a form of mist coolant is available.

Circle Item 107 on postcard, page 201

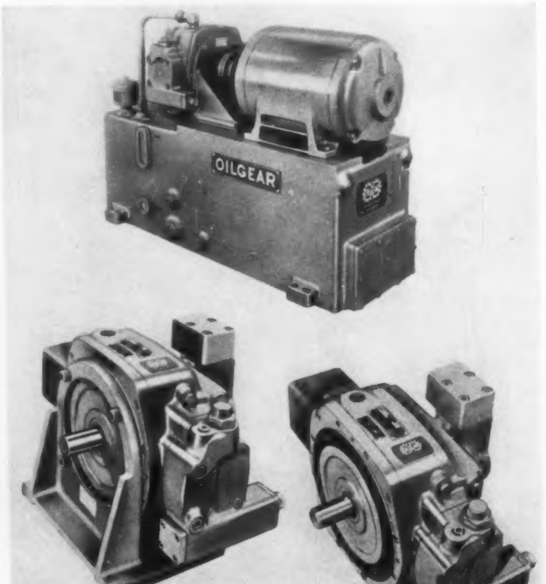
Oilgear Hydraulic Pressure Pump

A pump designed to serve as an efficient power source for presses and die-casting machines as well as transfer machines, hydraulic drives, and other machine tool applications has been announced by the Oilgear Co., Milwaukee, Wis. When the adjustable pre-set pressure is reached on applied work, the control hydraulically reduces the pump volume to save input power, reduce heat, and hold the pressure.

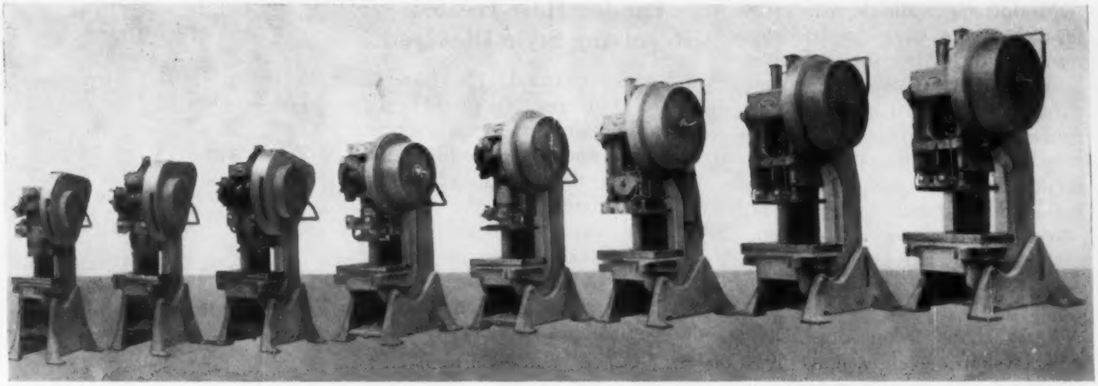
The pump, designated type "ANP," incorporates the manufacturer's exclusive radial rolling pistons. Other features are: balanced flat valve (port plate)



Ex-Cell-O precision boring machine developed for the production of very small, accurate bores



Oilgear pump for face, adapter, or angle mounting, with electric motor on standard reservoir base



Danly open-back inclinable presses with air-operated friction clutch and brake

for controlled oil film between working surfaces; separate wear plate; integral adjustable volumes and pressure unloading control; one-piece cylinder and shaft; bearing type slide-block; and large anti-friction bearings.

The pump may be supplied for either clockwise or counter-clockwise rotation. It is built for face, right-angle bracket, or adapter mountings, as well as standard or custom-built pump and motor base with reservoir. Driving speeds of 1750, 1450, and 1140 revolutions per minute are available which have delivery capacities of 3100, 2530, and 1950 cubic inches per minute, respectively. The working pressure range is from 200 to 1100 pounds per square inch. The net weight of the pump is 130 pounds.

Circle Item 108 on postcard, page 201

Open-Back Inclinable Presses of Welded Construction Equipped with Air Friction Clutch

A complete line of open-back inclinable presses with air friction clutches and welded steel construction is announced by Danly Machine Specialties, Inc., Chicago, Ill. The brake is air-operated and spring set. Efficiency of this clutch and brake has proved high in metal-stamping plants.

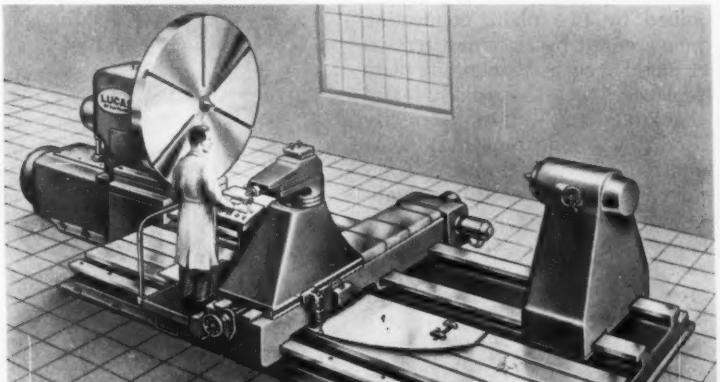
The press frames of welded-steel construction are designed to reduce deflection and vibration to a minimum and secure continued high production of accurately formed parts at standard stroking speeds. The size range is from 25 to 200 tons.

Circle Item 109 on postcard, page 201

Lucas Lathe for Turning Large Cylindrical, Conical, and Formed Work

A lathe designed for turning operations on cylindrical, conical, or developed shapes on lightweight pieces of great length and diameter has been announced by the Lucas Machine Division of the New Britain Machine Co., Cleveland, Ohio. This machine is available in semi-automatic, as well as tape-controlled, fully automatic models. As a semi-automatic machine, the Lucas lathe incorporates a one- or two-dimension electronic tracer control for cross-slide and carriage. In fully automatic models, cross-slide and carriage are controlled by punched tape numerical positioning or magnetic tape-contouring control.

Three hardened and ground ways support the carriage. On tracer-controlled models, flat templates are mounted on a T-slotted plate between the outer and intermediate ways. All functions are electrically operated. Speeds and feeds are infinitely variable and are controlled from a console mounted on an operator's platform attached to the lathe carriage. On varying diameters constant cutting speeds are maintained automatically by a unique selsyn feed-back system. With this system, in combination with pick-off gears, it is possible to cut a wide range of threads.



Lucas lathe designed to handle large work

Models are available with up to 96-inch swing over the bedways and up to 192 inches in length. Spindle, carriage, and cross-slide drives are powered by direct-current motors with power ratings selected to suit the job requirements. A motor-generator set is included as standard equipment.

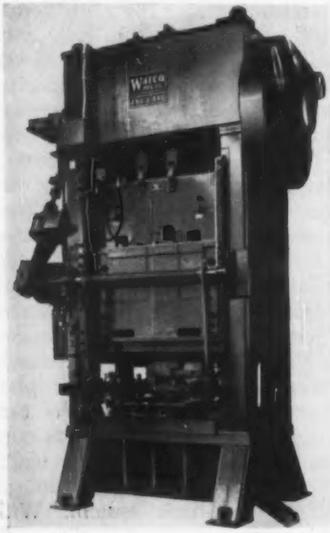
Circle Item 110 on postcard, page 201

Press with Automatic Feed

A Warco 250-ton double-eccentric shaft, straight-side press equipped with an automatic feed has been announced by the Federal Machine & Welder Co., Warren, Ohio. The feed, recently developed by the Warco Division of this company, feeds hot plowshare blades to the press for forming, coining, piercing, and countersinking operations. The shuttle type feeding unit is designed to carry the hot plowshare blades from the receiving station in front of the press to the work station. Following the press operations, the work enters a chute leading to an oil bath.

A hydropneumatic cushion is embodied in the press slide. A Warco pneumatic clutch-and-brake unit with push-button electrical control panel having "off," "inch," "short," and "continuous" positions, controls the press.

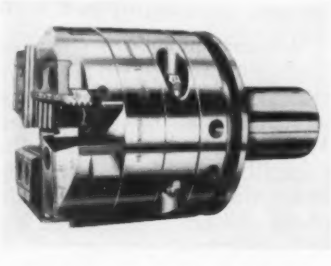
Circle Item 111 on postcard, page 201



Federal Warco press with automatic feed

Landex Heat-Treated Revolving Style Die-Head

A yoke-operated, JN Landex heat-treated, revolving die-head, for application to automatic screw machines and other equipment employing a "live" spindle, has been announced by the Landis Machine Co., Waynesboro, Pa. This die-head differs in design from the JX style Landex heads previously offered for automatic screw machine applications in that it does not incorporate a "floating" mechanism. The floating feature, which allowed a centering action between the die-head and work-piece in the event of misalignment, was obtained through the use of two 180-degree opposed, spring-loaded, connecting pins between the head-body and shank. With the trend toward higher speeds this floating action has been found inadequate.



Landis revolving style die-head

In the new JN Landex, the head-body and shank are rigidly joined by two plain, connecting pins secured by clamping screws. A single head-body retaining plate replaces the head-body and shank-retaining plates formerly used. By eliminating the "float" and reducing the number of components, the head's wearing qualities are said to have been enhanced. Most important, however, is the head's over-all increased rigidity, which results in higher quality threads.

The JN Landex head is recommended for commercial threading and is available in four sizes, 1/2, 13/16, 1 1/4, and 2 inches, having four standard ranges covering threads from the No. 4 to the 2-inch size.

Circle Item 112 on postcard, page 201

Fig. 1. Lennox Tru-Edge MetlMastr sheet metal cutting, beading, and forming machine

Lennox Sheet-Metal Shear and Drilling Machines

Lennox Tool & Machine Builders, Lima, Ohio, have announced the addition of Tru-Edge MetlMastr and Lennox-Demco sensitive drilling machines to their line of machine tool equipment. The MetlMastr, Fig. 1, is a highly versatile sheet-metal shear and forming machine. Square shearing, circle shearing, (up to 49 inches diameter inside throat) and free hand contour shearing of metal up to 9/32 inch in thickness can be performed on this machine. In-

Fig. 2. Lennox-Demco sensitive drilling machine

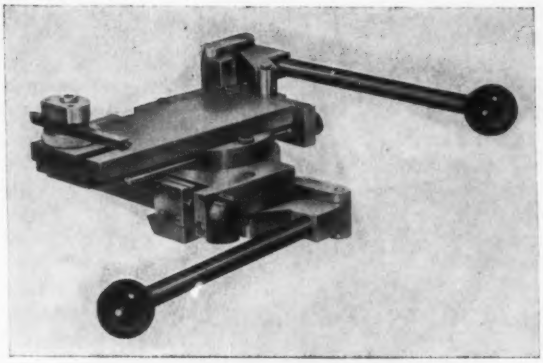


Fig. 1. Levin slide-rest for jeweler's lathe supplied with lever feeds

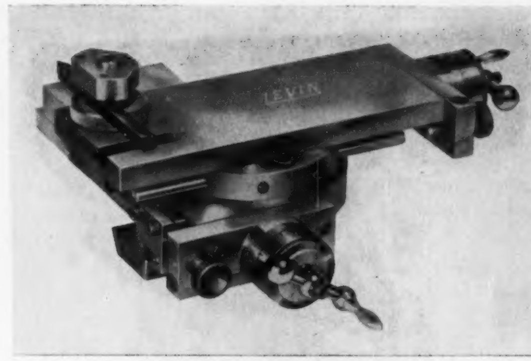


Fig. 2. Slide-rest for jeweler's lathe, equipped with screw feeds

side cuts can be made without the use of a starting hole.

Flanging, beading, joggling, planishing, edge bending, slot cutting, and louvering are some of the forming operations possible on the MetlMastr. It is available in three sizes: Models TE-165, TE-218, and TE-281, the numbers signifying the thickness of metal which each can cut.

The Lennox-Demco sensitive drilling machine, Fig. 2, is available in one-, two-, three-, four-, and six-spindle units. It features a multiple-spline spindle of such design that it is impossible for it to drop of its own weight when the operator is through drilling, a constant upward pressure always being maintained to eliminate all vertical lost motion. The spindle also automatically compensates or absorbs whatever wear takes place.

The current models have a capacity for drilling 1-inch holes in cast iron and 5/8-inch holes in mild steel. A wide speed range, power feed, back-gearing, hand tapping, and coolant systems are available features. The spindle has a travel of 7 inches and the table travel range is 17 inches.

Circle Item 113 on postcard, page 201

Slide-Rests for Jeweler's Type Instrument Lathes

Louis Levin & Son, Inc., Los Angeles, Calif., has brought out a heavy-duty compound slide-rest which fits all standard jeweler's type instrument lathes. This slide-rest is made with lever feeds on both slides as shown in Fig. 1 or with screw feeds as illustrated in Fig. 2. It can also be supplied with lever feed on either slide and screw feed for the other slide.

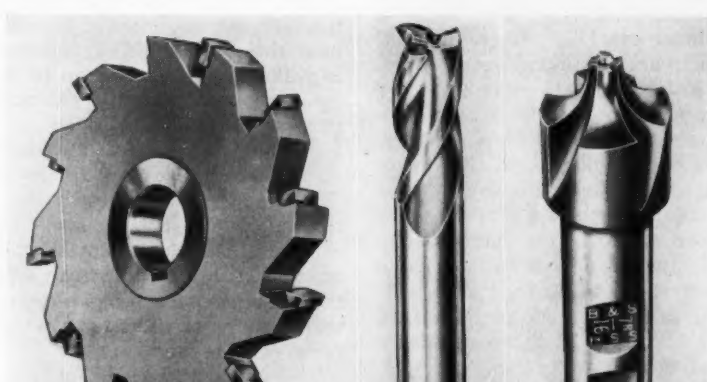
The lead-screw dials are 1 inch in diameter and have a non-glare finish. The swivel slide is locked with two T-bolts and will hold securely under any strain. Both slides are fitted with micrometer stops. A toolpost of new design eliminates the danger of breaking T-slots when clamping the tool.

Circle Item 114 on postcard, page 201

B & S Staggered-Tooth Side-Milling Cutters and End-Mills

Twelve Nelco Series 300, staggered-tooth, carbide-tipped side-milling cutters in widths ranging from 3/8 inch to 1 1/2 inches for cutting cast iron, brass, and bronze have been added to the 3200 "standard" tools available from the Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence, R. I. The positive radial and axial rake angles of these cutters (see view at left in illustration) provide for freer cutting, chip-breaking, and directing of the chips toward center of cut, thus insuring a smooth score-free surface finish. These cutters may be used singly or interlocked. They are especially recommended for cutting thin-walled sections or fragile castings. The shearing action permits smooth cutting without shock or chatter. Rigid, true-running bodies with overhanging tips allow regrinding of the carbide tips without grinding the steel body.

Ten Nelco Series 400, solid-



Cutters recently added to the line manufactured by Brown & Sharpe Mfg. Co.

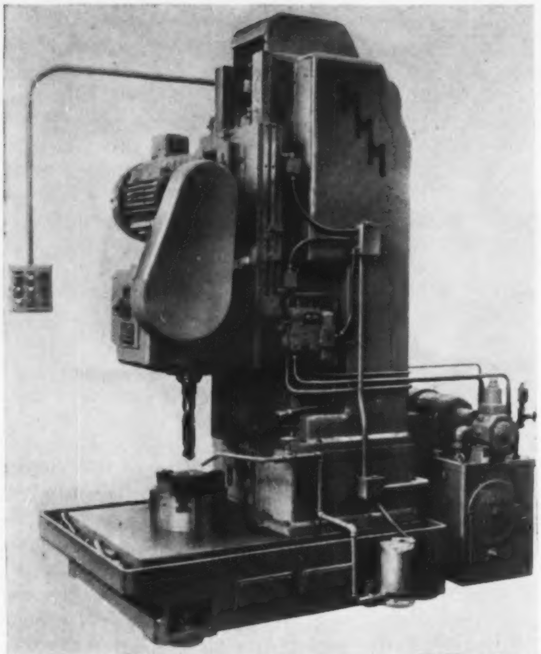


Fig. 1. Motch & Merryweather vertical drilling and boring machine

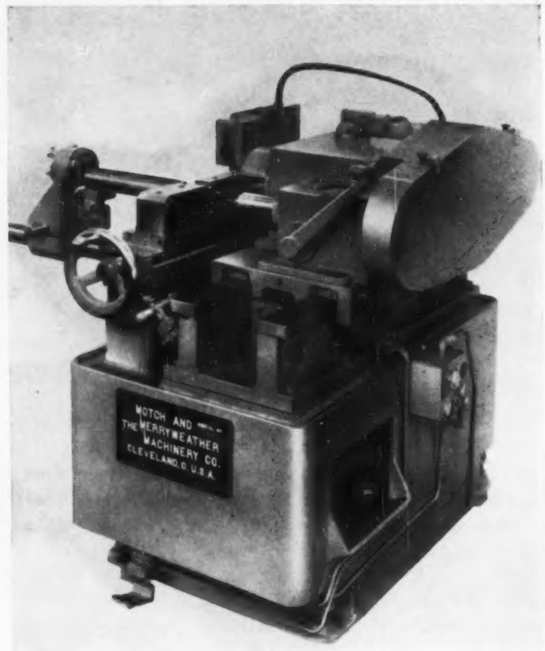


Fig. 2. Milling and centering machine introduced by Motch & Merryweather

carbide, center-cutting end-mills of the design shown in the center view of the illustration have also been added to the company's stock. These tools are said to be the only standard solid-carbide end-mills available that allow plunge cutting and peripheral milling as a single-setup operation. They range in size from 1/8 inch through 1/2 inch and are especially adapted for milling blind slots as small as 1/8 inch. The center-cutting feature serves to completely remove stock on plunge cuts. Sizes larger than 1/2 inch and left-hand spiral flutes can be furnished to order whenever they are needed.

Fourteen shank type, corner-rounding end-mills of the design shown in the view at right in the accompanying illustration have been added to the standard line of Brown & Sharpe cutters. These cutters are made for radius milling in a size range of from 1/16 to 1/2 inch. They are available individually or in a set of eight, mounted in a wooden block. These cutters are especially useful in rounding corners that are inaccessible to arbor type tools.

Circle Item 115 on postcard, page 201

Motch & Merryweather Special Machines

Three machines, all designed to handle small-lot, quick-change-over jobs, as well as high-production work, have been introduced by the Motch & Merryweather Machinery Co., Cleveland, Ohio. Two of these units are shown in Figs. 1 and 2. The third, not illustrated, is a multiple-spindle, vertical turning and boring machine which is available with either two or four spindles.

The vertical drilling and boring machine, Fig. 1, designed to combine ruggedness with versatility, is available in capacities up to 60 hp and with 15- and 30-inch strokes. The vertical slides are 26 inches wide, 48 inches long, and 20 1/2 inches across the ways. The feed valves have cam-actuated positive action, and the slide-mounted cams provide for quick changing of the stroke setting. The column can be arranged with a series of risers for a wide range of large work.

The automatic cycle of this equipment includes rapid traverse down, feed and rapid return, with variations of this automatic cycle available. The huge base of the machines contains a wide chip collection area with convenient cleanout doors and a built-in coolant system with coolant guard. The compact, external hydraulic system has a sealed sump. The column ways are hardened and ground, and there is a complete pressure lubrication system.

The single end-milling and centering machine, Fig. 2, is designed to handle a class of work encountered in practically all machine-building and metalworking plants. In most cases, the first operation on a cut-off piece or forged shaft or rod is its preparation for subsequent turning or grinding operations. That is the basic work for which this Model SMC machine was developed. It has its milling head and center-drilling head mounted on a slide actuated by a large pneumatic cylinder. The milling feed rate is controlled by a precision-adjustable hydraulic check valve, and the ways are automatically lubricated from the milling head.

The milling head is a standard M-5 unit. The center-drilling unit is powered by a belt from the main drive motor. Both the drilling and milling heads are pressure-

lubricated by an integral pump. The center-drilling unit has a quill stroke of 2 inches and is manually actuated. The stock support and stock gage can handle lengths from 4 1/2 to 48 inches. The gage can be indexed with a flat, adjustable stop for gaging from the rough end for the first milling operation. An adjustable center is provided for gaging the finished end for the second milling and centering operation. The adjustable support can be quickly set for various diameters and lengths as needed. The machine handles stock from 3/4 inch to 3 1/2 inches in diameter.

The third machine, not illustrated, is designed to handle a wide range of turning and boring work. It is available with either two or four vertical spindles. Each half of the machine may be run independently of the other. The drive spindles are cartridge type units and are mounted in separate sealed compartments to protect them against chips, dust, and coolant. The spindles are of heat-treated alloy steel and are mounted in precision bearings. They have a built-in draw-bar for use with rotating air cylinder and may be either direct or worm driven, depending upon the specific application. Available speeds range up to 5000 rpm.

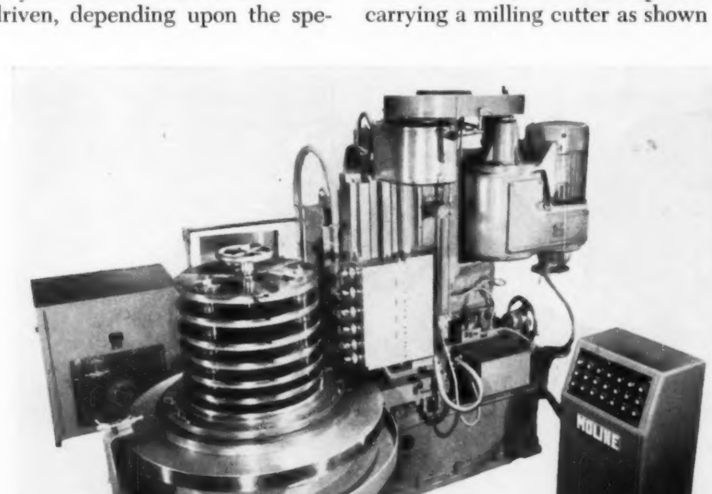
Vertical and horizontal slides are mounted on dovetail ways above each work-spindle. Each slide is fitted to the ways with adjustable tapered gibs. The slides are equipped with T-slots for use in mounting tool-blocks and have hydraulic feed, including rapid-traverse approach, dwell, and return. The strokes are adjustable and follow in automatic sequence. The vertical slides are provided with counterweights for smooth operation. Both the two- and four-spindle machines have separate external hydraulic systems with sealed sump, pump, and valves. The system is manifolded to the machine proper.

Circle Item 116 on postcard, page 201

Six-Spindle Machine for Milling Grooves and Ribs of Jet-Engine Compressor Housings

Six angular grooves and the tops of six ribs around the outside surface of jet-engine compressor housings are milled by a specially designed, six-spindle machine, Fig. 1, built by the Moline Tool Co., Moline, Ill. The light metal housing to be milled is set down over the manual clamping fixture which supports and clamps the housing from the inside at six levels. Prior to clamping, the compressor housing is positioned on the fixture in its correct radial location by sighting through an optical device.

Six horizontal, anti-friction bearing spindles are mounted in line on a slide, with each spindle carrying a milling cutter as shown in Fig. 2. This slide can be moved vertically by hydraulic power to the upper position shown, for milling grooves, and then lowered for milling ribs. When grooves are milled, the automatic operating cycle of the machine includes: plunge cut to depth; rotational feed of table through almost 180 degrees; withdrawal of cutters while a vertical rib moves past cutters; second plunge cut to groove depth; rotational feed of table through almost 180 degrees; withdrawal of cutters; and stopping of feed just before a second vertical rib reaches the cutters. When ribs are milled, the cycle consists of feeding milling cutters to depth; engaging feed which



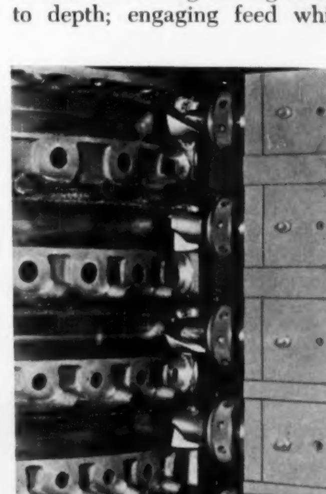


Fig. 1. (Left) Moline special machine equipped for milling grooves and ribs in jet-engine compressor housings
Fig. 2. (Right) Close-up of work on power-operated rotary table of machine shown in Fig. 1, with six high-speed steel fluted cutters in position for milling grooves

revolves table 360 degrees; withdrawal of cutters; and stopping.

The spindle drive permits speed variation through a range of as much as 6 to 1. The horizontal feed rate of the spindle slide is adjustable and is provided with positive stops to control depth of cut. Rotational feed rate of table also is adjustable. The coolant system includes a refrigerating unit that maintains the cutting compound at the correct temperature. The machine column can be moved toward or away from the table by means of a handwheel to permit the machining of parts from 24 to 52 inches in diameter.

Circle Item 117 on postcard, page 201

Di-Acro Hydra-Power Press Brake

A 25-ton, 6-foot bed, hydraulically operated press brake with an adjustable stroke and a dual-speed operating cycle has just been introduced by the O'Neil-Irwin Mfg. Co., Lake City, Minn. This machine, called the Di-Acro Hydra-Power press brake, Model 16-72, has a stroke-adjustment feature which enables the operator to preset the stroke of the ram in less than fifteen seconds to the narrowest possible opening for each job. This results in an efficient production rate because the rate of strokes per minute is increased as the stroke or opening is decreased. Also, there is little danger of the operator catching his fingers or hands between the dies when the stroke is pre-set for the narrowest possible opening.

The dual-speed operating cycle with power work-stroke feature automatically provides two speeds for the ram during each operating cycle. The ram travels at fast speed to a pre-set point just above the work, goes through the work part of the stroke in slow speed (with full pressure), and then resumes fast speed on the return portion of the stroke.

A combination hydraulic and mechanical system is used to power this press brake. The basic source of power is a hydraulic system with two oscillating, rotary type cylinders of different sizes mounted on the same shaft at the top of the machine. The shaft is mechanically linked to the ram through eccentrics on each end of the shaft. When force is applied to the cylinders, the resulting pressure transmitted to the work by the ram is always the same.

Length of stroke is controlled by rotation of the hydraulic cylinders. For example, when the maximum stroke or opening of 2 inches is pre-set by the stroke-adjustment selector, rotation of the cylinders is 270 degrees. When the stroke is set for a 1/2-inch opening, rotation of the cylinders is but 105 degrees. The ram is designed to assure accurate duplication of work. Adjustment of the ram need not be made when changing the length of stroke—only when changing dies or material thickness is it necessary to do this.

Circle Item 118 on postcard, page 201

Burgmaster Tape-Controlled Turret Drilling, Tapping, and Boring Machine

Automatic numerical tape controls are now being applied to the large, eight-spindle Burgmaster Model 3BH-T turret drilling machine and the 2BH-T, six-spindle machines built by the Burg Tool Mfg. Co., Inc., Gardena, Calif. The eight-spindle machine has a capacity for drilling and tapping holes 1 1/2 inches in diameter in

Di-Acro Hydra-Power press brake announced by the O'Neil-Irwin Mfg. Co.

Burgmaster tape-controlled turret drilling, tapping, and boring machine

mild steel. It utilizes an Electropoint control system or a General Electric tape control unit.

The standard table has a travel range of 18 by 30 inches, is mounted directly on the main column on dovetail ways, and is supported by double jack-screws. Tables with a travel range of up to 30 by 45 inches are available. Each axis of these tables is driven by a 1/2-hp servo-motor through a 5-pitch lead-screw of circulating-ball design. Lead accuracy is 0.0005 inch per foot. At one end of each lead-screw is a drive pulley. At the other is the measuring device. Rapid traverse is at the rate of 100 inches per minute.

Once positioned, the table is locked in place by air-actuated clamps for the machining operation. The turret-slide is locked out until the table is positioned, after which it will approach rapidly, feed, retract, and index automatically. The feed stroke for each spindle is controlled by the setting of a micrometer stop on a vertical drum. These stops operate micro switches which, through hydraulic valving, reverse the turret-slide. The machine has a throat depth of 19 3/4 inches and a clearance from spindle to table of 30 inches.

Provision is made for four methods of operation. By the first method manual control from the Burgmaster control station is used for setting up and individual operations. Manual control from the console cabinet is also permitted. A control switch disconnects the tape reader but permits the manual use of the motor drive to position the table which registers numerically on the display. With the second method semi-automatic operation of the tape reader, under full operator control, is used for checking out a new tape. In the third method automatic operation is employed in which all functions of the machine are directed by the tape control system for regular production. The fourth method consists of using the standard Burgmaster automatic hydraulic controls with the console shut down.

During the first three methods of operation, the display panel indicates the spindle sequence in operation and the exact position of the table in direct-reading decimals to plus or minus 0.0005 inch at all times. Regardless of whether the table is moved by power or hand crank, its position is always registered on the display.

The Electrosystem may be supplied with either of two methods of tape control and tape preparation: (1) simple hand punching of decimal numbers and spindle sequences in 10 5/8-inch wide by 0.005-inch mylar plastic tape at the rate of approximately one minute per command block. (A command block consists of two lines of punched information, one for the X axis and one for the Y axis and the spindle sequence for the location.) Tapes can be stored and used over a long period of time; (2) Flexowriter or IBM automatic typewriter using the standard eight-hole, 1-inch wide paper or mylar base tape for more rapid tape preparation. This method provides a printed record of the punched tape for checking purposes and permits the automatic duplication of punched tapes for multiple machine operations.

The system permits up to eight different operations to be performed at each table setting or each center location. The automatic system can be stopped and started at any position desired. Manual operations or movements can be interspersed with a tape program at any point without returning to the starting position or a reference point.

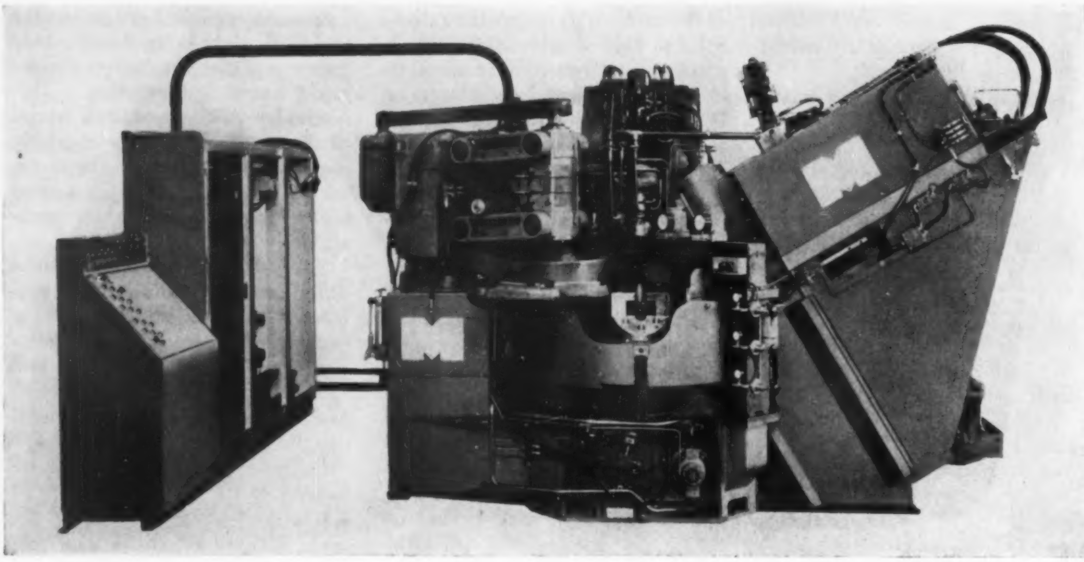
Circle Item 119 on postcard, page 201

Red Ring Automatic Gear-Inspection Recording Unit

A Red Ring gear-inspection recording unit that automatically checks gears for both size and helix-angle accuracy, rejects out-of-tolerance parts, and makes a chart record of the measurements is now available from the National Broach & Machine Co., Detroit, Mich. The inspection unit consists primarily of three separate components: a gear-gaging machine, a control panel, and a charting device. Gears to be inspected are fed into a storage chute in the gear-gaging unit. They are automatically advanced one at a time into gaging position, where a one-revolution check of size and helix-angle accuracy is made by rotating the gear in tight mesh with a rotating, upper master gear.

When a gear is in the gaging position against a locator, an air cylinder causes an arbor to enter the hole in the gear. Then the gear is rotated one revolution by a lower motor-driven gear that engages the work gear with back-

Red Ring gear-inspection recording unit that automatically inspects helical gears



Four-station grinding machine announced by Mattison Machine Works

lash. Angular and radial displacements of the upper master gear, which is braked slightly with an adjustable friction device, are measured by electronic sensing heads that cause out-of-tolerance gears to be dropped out of the exit chute of the gage. Signals from the sensing heads are picked up by the recording unit which indicates measurements in ink on a paper chart. Charted readings can be made either continuously at random, by push-button control, or intermittently in an automatic pre-set cycle.

The gear-inspection recording unit illustrated checks and charts helical, automotive, automatic-transmission pinions for helix-angle accuracy only. A chart of helix-angle measurements is made when desired by operating a push-button control. Any gear that is charted is automatically diverted to a separate collector unit in the gear gage. The helix-angle accuracy measurement as plotted by the charting unit is the tangent function of the helix-angle variation. From this reading, actual helix-angle variations in degrees can be calculated from trigonometric function tables. When both size and helix-angle variations are charted, separate pens for each variable are provided in the charting unit.

Circle Item 120 on postcard, page 201

Mattison Four-Station Grinding Machine

A four-station, automatic machine for rough- and finish-grinding the head-bearing sections of rock bits and similar parts used in the mining, quarrying, and oil-field industries is announced by the Mattison Machine Works, Rockford, Ill. This high-production grinder has considerable flexibility, being able to handle bit sizes ranging from 3 1/2 to 9 7/8 inches in diameter. The handling of this relatively wide range of work is made possible by the use of adjustable fixtures.

Three work stations, plus a load and unload station, are included in the grinder. At work station No. 2 the top of a pin is ground flat. At station No. 3 the pin diameter is rough-ground during the first part of the cycle, the pin and the adjacent shoulder are rough-ground, and the pin is chamfered at the end of the cycle. At station No. 4 the pin diameter and shoulder are finish-ground. The entire machine cycle is automatically controlled from the console's indicator lights, which provide a visual record of the work status.

In addition to the automatic cycling of work, provision is made for precision automatic sizing to compensate for wheel wear. Following each operation, the pieces are automatically gaged. The gaging head is equipped to signal the machine to feed in as required so that the work is always finished to size within the specified limits. A patented package grinding head with parallelogram type mounting is used at station No. 2, and inclined heads are used at the third and fourth stations. Two basic types of parallelogram-mounted Mattison face-grinding heads are available in three sizes and in precision or foundry models. As the name indicates, precision models are for jobs where a high degree of accuracy is required, while foundry models provide for a high rate of metal removal or rough-grinding. These grinding heads have completely sealed, pre-loaded, bearing journals and will operate equally well in any position. The precision type grinding head incorporates a hydraulic cylinder feed working against an adjustable lead-screw stop. Both rapid-approach and fine-feed strokes are provided for in this design, and both have controllable feed rates and adjustable limits.

The lead-screw has rapid traverse in and out, plus a variable increment jog infeed, making the head unit well suited for cycling operations and automatic size-control systems. Precision limit

switches are included to control and interlock all operations. A coolant separator is provided with the machine to maintain the highest possible level of grinding efficiency despite a high-production rate. Package grinding heads of the parallelogram design can be provided in motor sizes ranging from 5 to 125 hp. Hydraulic motors are used to index the machine table and drive work-holding chucks. Four hydraulic pumps of the variable-volume vane type are provided.

Circle Item 121 on postcard, page 201

Federal Machine for Seam Welding Stainless Steel and Titanium Alloys

A three-phase, rocker-arm type seam welder has been developed by The Federal Machine & Welder Co., Warren, Ohio. This special machine resistance seam welds stainless steels (0.012 through 0.051 inch thick) and titanium to titanium alloys (0.016 through 0.051 inch thick) in accordance with Air Force-Navy Aeronautical Specifications. Firing of machine is accomplished by a precision differential switch. Drive speeds are steplessly adjusted by a direct-current, Thymatrol type, motor-drive system mounted on the lower arm. The driving speeds range from approximately 0.5 to 4 rpm.

The machine has an essentially frictionless, constant-pressure type air-pressure system, with electrode force adjustable from 250 pounds to 2000 pounds at 80 pounds per square inch. The lower arm horn is arranged with interchangeable hubs to facilitate quick changing of the various sizes of electrode wheels.

The working stroke is 3/4 inch and the retraction stroke 4 inches. An electronic, three-phase to single-phase, low-frequency converter, seam-welder control is utilized to insure uniformity of each secondary current cycle.

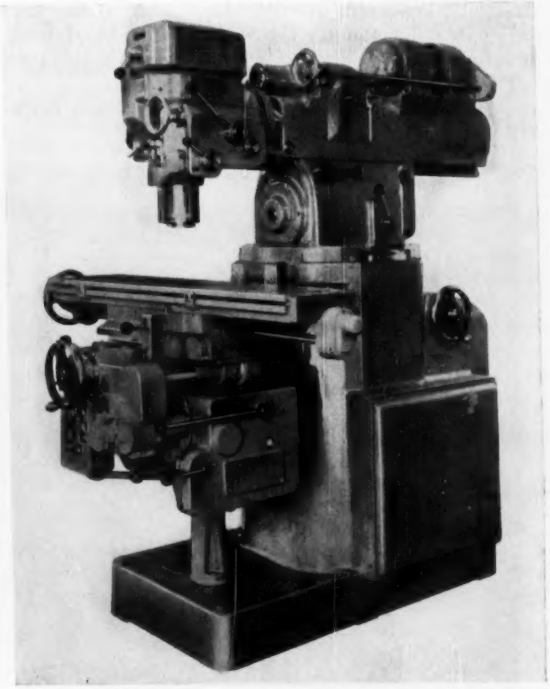
Circle Item 122 on postcard, page 201

"Quartet" Vertical-Head Milling Machine

A self-contained, heavy-duty, vertical head is now available as an optional accessory for the "Quartet" milling machine, manufactured by the U. S. Burke Machine Tool Division, Cincinnati, Ohio. The 3-hp, quill type, vertical head is designed to increase the range of the "Quartet" unit. This machine is adaptable to every type of milling operation—horizontal, vertical, angular, and universal. Among the chief features of the new head are the triple row of pre-loaded, angular contact, high-precision ball bearings mounted at the lower end of the spindle to provide maximum support.

The quill is hard-chromium-plated, 4 5/8 inches in diameter, and has a travel range of 6 inches. Spindle speeds are infinitely variable from 80 to 4200 rpm with an optional range of from 40 to 2100 rpm. The machine is equipped with a built-in tachometer and is furnished with a heavy-duty, hardened and precision-ground, chromium-nickel steel spindle with No. 40 N.M.T.B. taper. The quill feed rate is infinitely variable

Seam-welding machine developed by the Federal Machine & Welder Co.



U. S. Burke "Quartet" milling machine with self-contained vertical head

Fig. 1. Magnaflux unit that locates circumferential defects of part in coil by simultaneous actuation of current and flooding with magnetic particles

from 0.002 to 0.008 inch per revolution both up and down, without reversing the direction of motor or spindle rotation. Both manual automatic knockouts are provided for controlling the feed in both directions.

The unit has a quill lock and an "automotive type" spindle brake. It has worm and worm-wheel angle positioning of the head to 360 degrees and rack-and-pinion ram positioning. Included also are coarse hand feed, fine hand feed, and power feed with built-in interlocks and safety clutch.

Circle Item 123 on postcard, page 201

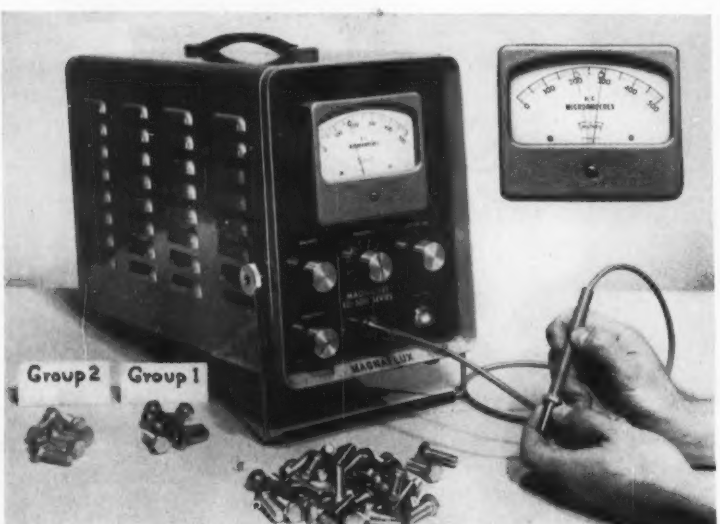


Fig. 2. Using all-purpose probe of Magnaflux ED-500 unit to segregate mixed lot of steel bolts

Magnaflux Testing Equipment

The Magnaflux Corporation, Chicago, Ill., will exhibit and demonstrate a complete range of non-destructive testing systems and equipment at the 1958 National Metal Exposition. Included among these will be newly developed magnetic-particle testing units; eddy-current, crack detector and sorting instrument; magnetic-field measuring devices; fluorescent-penetrant testing methods; and ultrasonic, thickness measuring instruments.

On display for the first time will be the NQ-242 testing unit, Fig. 1, which is the latest addition to the group of Magnaflux testing equipment. It employs the new water-suspendible magnetic-particle inspection method—either visible or fluorescent—and provides a rapid means for production testing of small ferrous parts up to 24 inches long. New features include suspended magnetizing coil and heads to permit conveyorization of parts either through or across the unit. Recessed front panel construction provides for sit-down operation. Other features include: removable and reversible grills; infinitely variable current control; built-in line disconnect switch; and stainless-steel tanks to accommodate either oil or the new water-suspendible magnetic-particle baths. The unit, which operates on 220- to 440-volt, 50- to 60-cycle, three-phase current, has a direct-current magnetizing output of 1750 amperes through the heads.

The Magnatest ED-500 eddy current instrument, Fig. 2, is designed to locate and determine the relative seriousness of defects in all conductive materials. It also serves as a comparator to sort ferrous and non-ferrous metals. Sorting for hardnesses or differences in alloys and heat-treatment conditions can be done by placing the probe on the surface to be tested, as shown in Fig. 2, and observing the needle deflection of the meter located on the front panel of the instrument. "Lift-off" compensation permits use on relatively rough surfaces.

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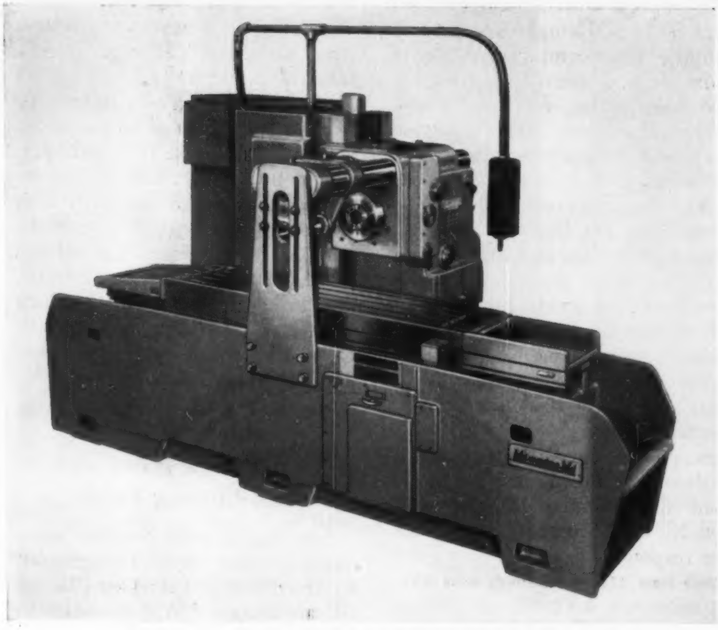

Fig. 1. "Mil-waukee-Mil" bed type milling machine introduced by Kearney & Trecker Corporation

Bed Type Milling Machine with Dial-a-Cycle Control

A bed type milling machine, Fig. 1, called the "Mil-waukee-Mil," which provides for automatic production milling by dialing information directly from a blueprint, has been announced by Kearney & Trecker Corporation, Milwaukee, Wis. The operator simply dial-programs the machine functions on the unique Dial-a-Cycle control panel, Fig. 2, by means of phase-switch dials, which control each machine function automatically. Any number of functions can be incorporated in a cycle, including automatic quill retraction, rise and fall of the head, and tracer control.

Two-way milling cycles with automatic center stop for loading and unloading can be obtained by merely pressing a button. Stops can be made to occur at any place in the cycle. The change from automatic Dial-a-Cycle to manual operation is made by the flick of a switch.

There are seventy-two standard models to choose from in both simplex and duplex styles, with power ranging from 7 1/2 to 30 hp. By including such optional extra-cost features as automatic quill retraction, vertical power feed, and tracer control, it is possible to provide machines for specific milling requirements.

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Direct-Current Arc-Welding Machines

Three arc-welding machines for general industrial and field use have been announced by Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City. The new models include an Aircomatic Fillerarc welder designed for the consumable-electrode, gas-shielded welding processes; two Airco Hornet 36B motor-generators for both metal-arc and inert-arc welding; and two Yellow Jacket water-cooled, engine-driven welders for field service.

The Aircomatic Fillerarc motor-generator machine, illustrated, is designed for application of the

Fig. 2. Dial-a-Cycle control panel of machine illustrated in Fig. 1

Aircomatic Fillerarc welding machine announced by the Air Reduction Sales Co.

gas-shielded metal-arc processes where equal burn-off rate and wire-feed must be maintained. Its rising volt-ampere curve reacts instantaneously to all wire-feed speed changes to maintain constant arc length. Current rating is 450 amperes continuous; weight, 840 pounds; height, 28 3/4 inches; width, 20 5/8 inches; and length, 34 5/8 inches.

The Hornet 36B motor-generator is available in 300- and 400-ampere models and is designed for light, medium, and heavy-duty, direct-current, metal-arc, and inert-gas-shielded arc-welding. Quick response and a well-controlled arc enable vertical and overhead work to be handled without excessive spatter or special adjustments. Controlled current peaks result in faster welding speeds and stronger welds. Wide current range—60 to 375 amperes with 300-ampere unit and 80 to 500 amperes with 400-ampere unit—complete phase insulation and sturdy construction are outstanding features. These motor-generators are designed and built for stacking one on top of another.

The direct-current Yellow Jacket welders are built in 300- and 400-ampere sizes and are particularly suited for pipeline and construction work welding in the field. These machines, driven by Hercules engines, feature high recovery voltage, eliminating "pop-outs" with any size and type of electrode; provide controlled current peaks for good penetration without burn-throughs; minimum load drop-off that results in a steady, even current; and quick arc response.

Circle Item 126 on postcard, page 201

Bodine Production Machine Equipped to Perform Twelve Operations

The Bodine Corporation, Bridgeport, Conn., has equipped one of its basic machines for processing a precision steel clutch drum at a production rate of 300 pieces in fifty minutes. The unusual tooling setup on this machine performs twelve operations and is said to have improved quality control of the product.

The tool equipment includes three horizontal drill spindles, one horizontal tap spindle, four vertical drill spindles, one vertical milling spindle, and two inverted drill spindles—one with a two-spindle head. All work is held to close limits. In order to assure freedom from damaged parts or rejects, two automatic inspections are included in the cycle. An unusual feature is the use of a special recessing tool on the inverted spindle to undercut teeth on the internal diameter of the part. This had to be developed as part of the job. Parts are manually loaded and unloaded, automatically clamped, and inspected for position. Each work-holding station is automatically "washed out" before a new part is inserted.

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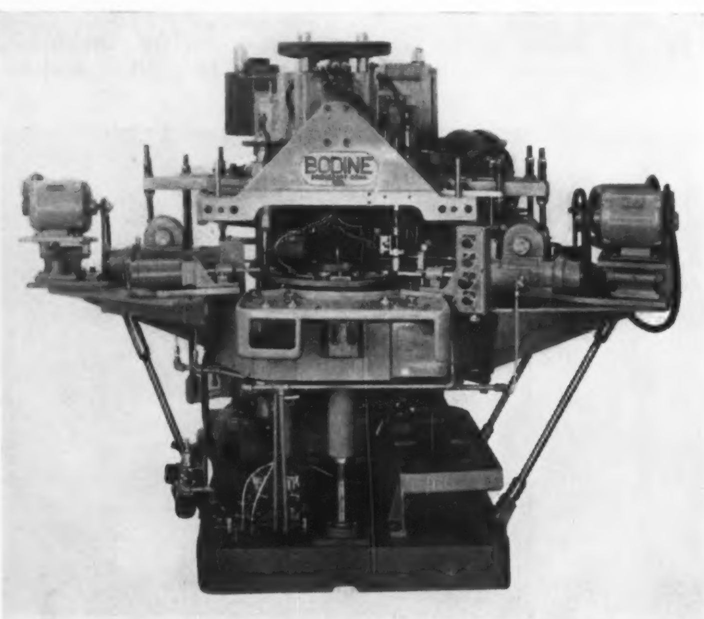

Machine for processing steel clutch drums built by Bodine Corporation

DoALL Saw Band with Fast-Cutting Teeth

Saw bands with positive rake-angle or claw teeth, brought out by the DoALL Co., Des Plaines, Ill., are designed to give maximum efficiency in sawing thick-section material. These bands are claimed to be faster penetrating, longer lived, and to require less feeding pressure than the blades they replace. Extensive cutting tests, Fig. 1, have been performed on samples of work submitted by the users of DoALL metal-cutting machines using saw bands with the new claw-tooth design, Fig. 2. The 9 1/2-inch diameter, Rycut (alloyed steel) bar shown in Fig. 1 was cut off in fifteen minutes with one of the new Demon high-speed, 4-pitch, 1-inch wide, claw-tooth bands.

The claw tooth is characterized by a forward slanting tooth face which evolves into a long, smooth, carefully plotted, somewhat elliptical gullet. The forward hook, or "positive rake," is based on the same chip-generation principles that have proved so successful for lathe tools, milling cutters, etc.

Demon claw-tooth saw bands are available in six widths from 1/4 inch through 2 inches, and in four pitches. In the 1-inch width, all four pitches (2, 3, 4, and 6 teeth per inch) are available for the DoALL power saw, a heavily powered, ruggedly built unit designed especially to utilize this blade for cut-off work. In the 1-inch width, three different gages are used, depending upon the application. The normally used gage

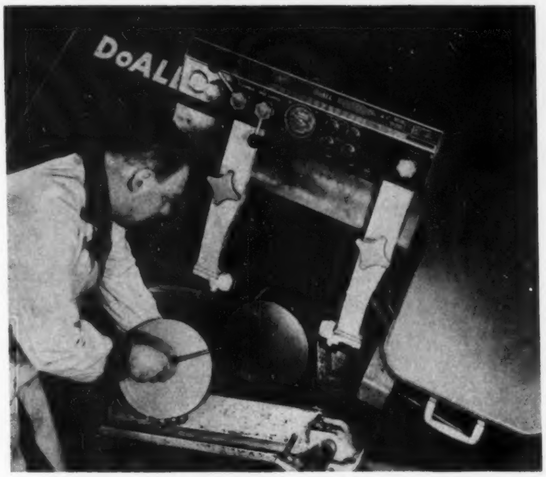

Fig. 1. Cutting off alloy steel bar 9 1/2 inches in diameter in fifteen minutes with DoALL Demon blade

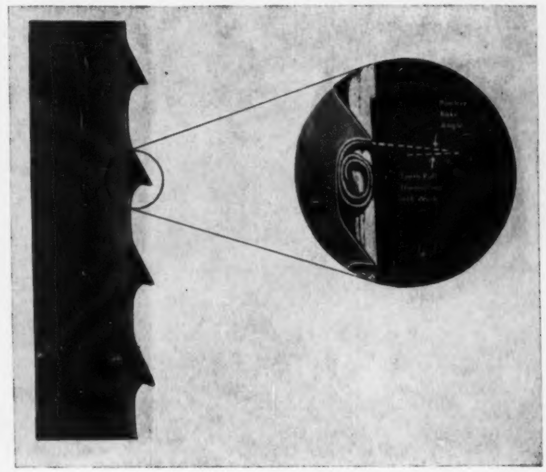

Fig. 2. DoALL claw-tooth saw band with gullet designed to obtain maximum effectiveness of positive rake angle

is 0.035 inch. Greater beam strength is permitted by the 0.042-inch gage intended for extreme accuracy in cut-off work on high-alloy steels and heavy sections. It is recommended for use on tool steel, stainless steel, high-temperature alloys, and titanium. The 0.050-inch thick band is recommended for accurate cutting of heavy sections with powerful, large capacity, contour-sawing machines.

Circle Item 128 on postcard, page 201

Portable Riveting Tools

Two lightweight riveting tools designed for both assembly operations and product maintenance or repair work have recently been announced by the "Pop" Rivet Division of United Shoe Machinery Corporation, West Medway, Mass. These tools can be used for setting small rivets up to 3/16 inch in diameter in standard, overhead, or blind applications. One, a hand tool, slightly larger than ordinary household pliers, will set aluminum rivets 3/32, 1/8, or 5/32 inch in diameter, and Monel or steel rivets up to 1/8 inch in diameter. The other tool, an air-hydraulic gun type that weighs approximately 2 pounds, will pull Monel rivets up to 3/16 inch in size.

The powered tool, designated a PRG hydraulic gun, consists of an air-hydraulic intensifier, a portable riveting gun, and connecting hoses. The intensifier is connected directly to the shop air outlets and operates at pressures of 70 to 100 psi. At minimum operating pressure, pistol ratios boost this to 2700 psi at the hydraulic end—a booster ratio of approximately 40 to 1. Maximum air consumption at 1200 cycles per hour is 1.04 cubic feet per minute.

The intensifier is connected to the riveting pistol or gun, which weighs only 2 pounds 3 ounces. Standard hose length is 8 feet although the gun will operate satisfactorily at lengths up to 11 feet or more. The rivet can be placed either in the gun or the work, and the cycle completed by a light squeeze on the spring trigger.

Advantages of this tool are said to be simplicity of operation; adaptability to a variety of rivet sizes through universal, quick-change collets; high-cycle speed; and the facility with which it can be used in overhead, blind, and restricted areas.

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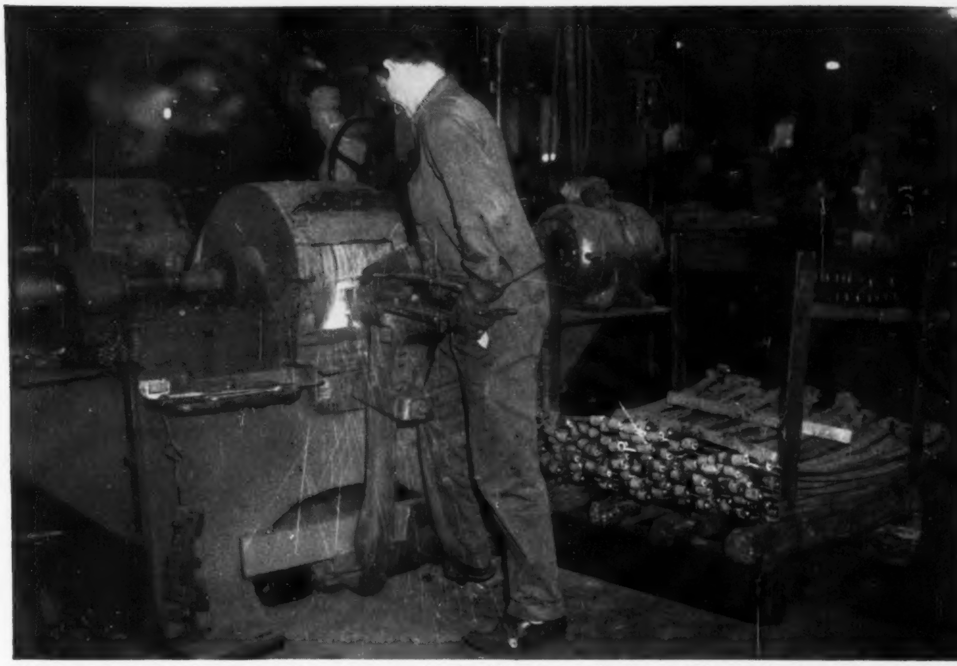
(This section continued on page 198)

Portable riveting tool brought out by the "Pop" Rivet Division of United Shoe Machinery Corporation

How Warren Pouyer cut grinding

Six years as a tool and die maker gave Bay State's Warren Pouyer a basic knowledge of precise metal working problems that many an "expert" would envy. For the last nine years, he has specialized in abrasives and has gained a tremendously wide knowledge of grinding methods and materials.



Moog operator gets heavy, rapid stock removal using Bay State wheel to grind eye of automobile spring leaf.

costs 1/3 at Moog Industries

Too many wheels were being used up too fast. That was the basic problem in the spring eye grinding operation at Moog Industries, St. Louis, Mo. A leading manufacturer of truck, trailer and automobile springs, Moog makes a complete line of front-end, chassis parts . . . and in this highly competitive business, keeping grinding costs down is vitally important.

So they called in Warren Pouyer of Bay State distributor Mill Supply & Machinery Company and he spotted the trouble right off the bat: disc grinding wheels of a specification that looked as if it *ought* to be right but wasn't. Pouyer specified the proper Bay State wheel using a semi-friable type of aluminum oxide with a unique combination of grit sizes. Production increased 33% per wheel without loss of operation speed.

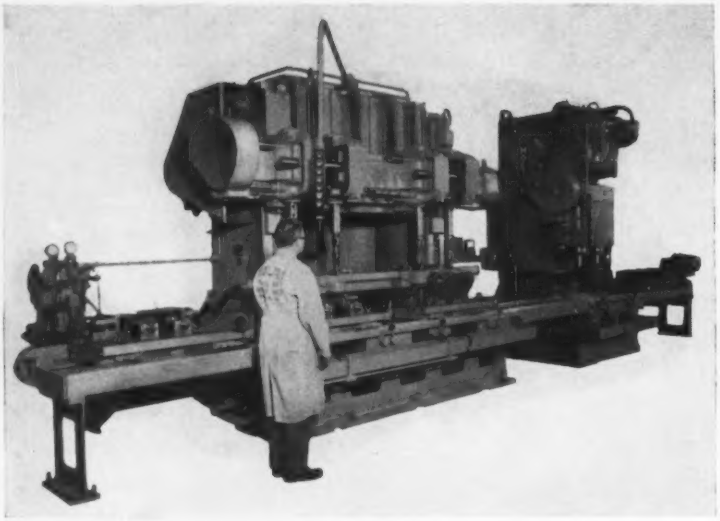
Since then, the Bay State wheel has been competitively tested over and over again and it has come out on top every time . . . a tribute to Warren Pouyer's ability to specify exactly the right wheel, in this case the first time, and to Bay State's ability to reproduce a given spec *exactly* and *consistently.*

Warren Pouyer doesn't solve all his grinding problems as quickly as this. Like all Bay State representatives, he's trained to study every problem *thoroughly.* And whether a particular problem has a simple solution or a tricky one, you can be sure *your* Bay State man will stick to it until he works out a practical, economical answer. *Better grinding at lower cost—that is his business.*

BAY STATE WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh. *Distributors:* All principal cities.



Moline drilling and boring machines combined with transfer track and platen type work-holding fixtures for processing heavy steel links

Moline Three-Station, Two-Unit Drilling and Boring Equipment

Heavy steel links are drilled, core-drilled or reamed and finish-bored as they are passed along, on platen type work-holding fixtures, through the three working stations of a combination machine built by the Moline Tool Co., Moline, Ill. The first and second working stations of this equipment are a Model HD68 drilling machine which carries two pairs of spindles on the machine rail. Each pair is adjustable from 8 inches minimum to 36 inches maximum center distance. The links are drilled from solid steel by the first pair of spindles. The various sizes of links require drills ranging from 1 inch to 2 1/2 inches in diameter and the spindle drive is equipped with four quick changes of spindle speed to provide suitable surface cutting speeds. The second pair of spindles on the drilling machine enlarges the previously drilled holes by core-drilling, the maximum diameter being 3 3/8 inches.

The third working station is under the two spindles of a Model 115CB boring machine where the drilled holes are finish-bored for accuracy, parallelism, and surface finish. The boring spindles are adjustable for the same center distances as the drilling spindles. The flange-mounted boring-bars can be run at spindle speeds which are adjustable through a 133- to 400-rpm speed range by a remote controlled, variable-speed drive. Pick-off type gears can be changed if it is desired to increase or decrease the speeds, although the remote-controlled range remains constant at a 3 to 1 ratio.

Fixtures on the platens will handle a variety of links. The platens are moved along the transfer track by a power-operated mechanism.

Loading of spindle-drive motors, and spindle speeds in revolutions per minute can be read directly from meters permanently mounted on the machine.

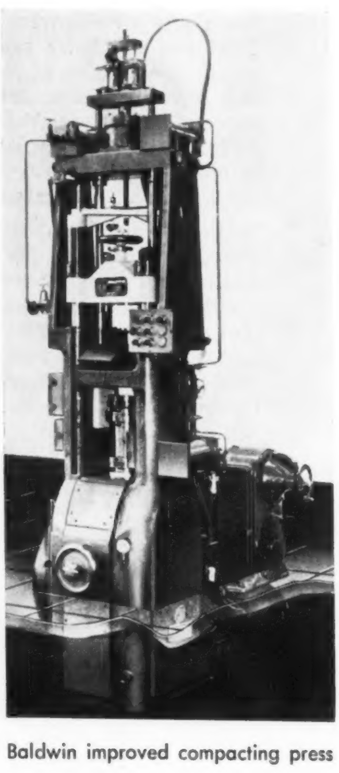
Circle Item 130 on postcard, page 201

Improved High-Speed Compacting Press

A Baldwin 75-ton compacting press, built for high-speed, high-quality production, and to eliminate powder loss, has been introduced by the Hamilton Division, Hamilton, Ohio, of Baldwin-Lima-Hamilton Corporation. This press, designated Model 75-A, is designed for compacting such materials as powdered metals, abrasives, carbides, ferrites, and nuclear and other solid fuels for rockets and missiles. It is a completely redesigned version of Hamilton's previous Model 20-A high-speed, high-accuracy compacting press.

Design changes include: new upper housing, a pair of spring-loaded powder cut-offs on shuttle feeder, relocated die float upstop, and die float downstop of increased capacity.

The press uses a separate die-holder and now has a completely new upper housing that permits the feeder to be connected directly to the die-holder. This setup practically eliminates powder loss with its accruing expense and dirt problems. The die float upstop has been removed from the die area and placed where it will not become accidentally contaminated with powder. The stop position is adjustable, and the shuttle feeder has spring-loaded cut-off rings between shuttle and hopper as well as between shuttle and die surface to cut powder loss to a minimum. Capacity of the die float downstop has also been increased. This stop is adjustable to permit control of the distance the die can float.



Baldwin improved compacting press

Available press accessories include an arrangement for holding the top punch against the part during ejection to prevent laminations or shear cracks. This feature is particularly important for producing parts made of materials that have a high elastic recovery. Tools for the 20-A press are interchangeable with those of the new 75-A and, with adapters, tools from other presses also can be used.

Circle Item 131 on postcard, page 201

Gear-checking machine announced by the Cosa Corporation

Mechanical Die-Tryout Presses

A 300-ton press has been added to the line of mechanical die-tryout presses made by Alpha Press & Machine, Inc., Detroit, Mich. Its unique feature consists of a slide that can be rotated up to 270 degrees from its normal position, permitting the diemaker full accessibility to the die with complete safety. Less than a minute is required to return the slide and upper half of the die to the running position, where it can be tried, or even used for a production run.

The slide has a stroke of 8 inches and a motorized adjustment of 12 inches. Shut height from bed to slide, with stroke down and adjustment up, is 36 inches. The bed area is 84 by 48 inches. A variable-speed drive provides a range of ten to thirty strokes per minute. An electric motor rotates the slide at the rate of one revolution per minute through 105 degrees (—15 degrees from its normal operating position. The main drive is by a 30-hp motor.

Since dies can be loaded into the press with an overhead crane and need not be removed until the desired stamping is produced, tryout time is reduced.

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Alpha mechanical die-tryout press

Mahr Gear-Checking Machine

A Mahr 890 involute measuring machine for checking internal and external involute, tooth-flank profiles on spur, helical bevel, and worm gears is now available from the Cosa Corporation, New York City. Provisions for making infinitely variable, optical, base-circle settings for gear diameters between 0 and 20 inches, without the need for base-circle discs is a time-saving feature of this equipment. This also permits the testing of very small gears and pinions.

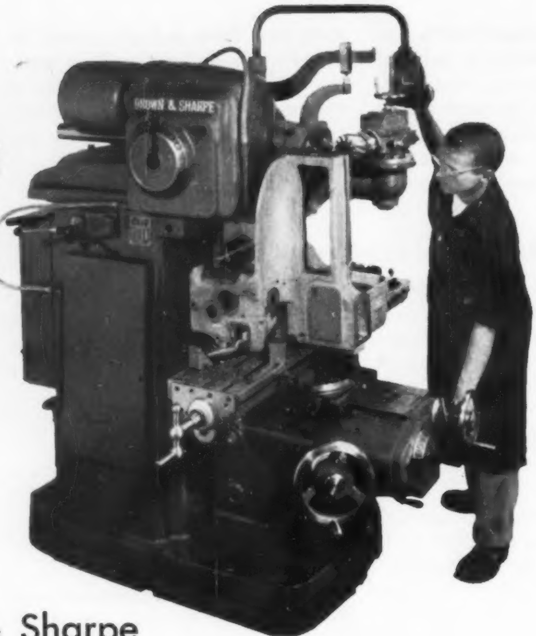
Extremely accurate checking is guaranteed by a highly sensitive, shock-proof stylus and a recording magnification of 500 and 1000×. Roll ratios are adjustable to 1 to 1, 2 to 1, and 4 to 1. A holding device for bevel gears that can be swung through 105 degrees (—15 degrees to +90 degrees) and is set with slip gage-blocks is also a feature. An offset stylus is used for the inspection of internal gears.

Gears to be inspected are held either on arbors or between centers up to a maximum distance of 16 inches. Both centers are carbide-tipped. The driver is adjustable to any shaft diameter. Gears with diametral pitches from 1 1/2

(Continued on page 206)

'way out ahead in WORK RANGE –in OPERATING ECONOMY

For tools, dies, molds, for prototype work, for maintenance, for any milling job—



COMPARE this capacity!

28″ Table feed
12″ Transverse feed
25″ Face of column to center line of vertical spindle
20½″ Vertical feed
3½″ Hand movement of quill in universal head.

Spindle Speeds
Horizontal Spindle
40 to 1530
Universal Head
80 to 3060

The Brown & Sharpe RANGEMASTER

Universal & Plain Milling Machines — sliding head type

LOWER ORIGINAL INVESTMENT

On the RANGEMASTER you can take No. 2 size cuts on work pieces whose physical dimensions would normally require the capacity of a more expensive No. 3 or larger size machine.

LOWER SET-UP AND OPERATION COSTS

With the RANGEMASTER you *clamp the work piece once*, then machine all around it – mill, drill, or bore from any angle. You avoid relocating and re-alignment, with consequent risk of errors. You get more hours of machining time, and minimize set-up time.

LOWER TOOLING COSTS

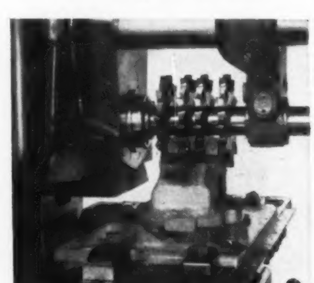
In the RANGEMASTER, both horizontal and vertical spindles have the same standard No. 40 M.M. taper for interchangeability of tooling. One set of tooling serves for multiple operations. There's no need for costly compounding of tool inventory.

Compare all the features of the RANGEMASTER, Universal or Plain Type, and you'll agree it's by far your best buy in its class. For details, write: Brown & Sharpe Mfg. Co., Providence 1, R. I.

ALL THE ADVANTAGES OF A "RAM-TYPE" MACHINE WITH NO SACRIFICE IN CUTTING ABILITY

In the Rangemaster, all the following features are the same as in a conventional knee-type milling machine of corresponding size:

SAME SPINDLE MOUNTING —
SAME SIZE "BULL" GEAR —
SAME RANGE AND NUMBER OF SPINDLE SPEEDS —
SAME DIRECT DRIVE to both spindles, utilizing full power



Positioning of sliding head adjacent to the work piece permits mounting of cutters close to spindle nose for improved cutting ability.

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Brown & Sharpe BS

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PRODUCT INFORMATION SERVICE

Use postage-free Business Reply Cards for further information
On New Catalogues described in this issue of MACHINERY
On New Shop Equipment described in the editorial pages
On products shown in the advertisements

NEW CATALOGUES

RESEARCH FACILITIES—U. S. Industries, Inc., Chicago, Ill. Book called "Facilities and Technical Personnel for Research, Development and Manufacturing," describing and illustrating the facilities of this organization. For information on research, write Kett Technical Center, P. O. Box 2021, Pompano Beach, Fla. With reference to engineering and manufacturing, write Vice-President—Operations, U. S. Industries, Inc., 250 Park Ave., New York City.

ROLLER CHAINS AND SPROCKETS—Link-Belt Co., Chicago, Ill. 154-page Book 2657, detailing engineering data that illustrates the roller chain's versatility in a wide range of applications. It contains typical installation conditions, formulas, charts, and diagrams to simplify selection of proper chains for any application. "Keydexed" for easy reference, the book describes the selection, application, installation, lubrication, and maintenance of roller chains and sprockets for drives and conveyors. A table lists the degree of resistance of these metals to almost four hundred corrosive agents. **1**

DIES—Standard Pressed Steel Co., Jenkintown, Pa. Bulletin featuring aircraft-quality thread-roll dies, now available to industry for producing external screw threads in both fine and coarse series. Available in all standard thread sizes from No. 10-32 to 1-14 threads, the flat dies are identical with those used by the firm in producing airframe and high-temperature engine bolts and a variety of titanium fasteners. **2**

FASTENER APPLICATIONS — Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Pocket-size booklet, "Helpful Hints," containing technical facts to help users obtain maximum economy and perfromance in application of standard fasteners. Information is contained on selecting the right grade of bolt, proper torque for bolts, bolt stresses, calculating proper bolt loading, tightening limitations, safety factor, threads, and protective coatings. **3**

STAINLESS STEELS—Armco Steel Corporation, Middletown, Ohio. Booklet presenting 2 types of ELC (extra-low-carbon) stainless steel. Types 304L and 316L are described as providing the simplest and most economical means of preventing harmful carbide precipitation in stainless-steel weldments. Chemical analyses and typical mechanical properties are given. **4**

WIRE CUTTER AND STRIPPER—Jennings Machine Corporation, Philadelphia, Pa. Bulletin presenting a new, completely automatic, high-speed machine—the Acme wire cutter and stripper. Table gives specific information on production rates (up to 9000 pieces per hour) versus wire lengths (up to 120 inches). Tolerances, types of insulated wire handled, and operating features are also covered. **5**

ASSORTED TOOLS—Cowles Tool Co., Cleveland, Ohio. 48-page catalogue No. 571, featuring milling cutters, standard and special types of high-speed steel, or carbide-tipped; broaches, grooving tools, spar mills, chamfering and boring tools, reamers, slotting saws, rotary slitting knives, spacers, and a wide variety of other special-purpose tools. **6**

CUTTING MACHINE—Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. Folder, DH-106, describing the company's Model 1-A "Sever-All" dry abrasive cutting machine. Specifications such as rated capacity, power required, cutting-wheel diameter, dimensions and weights are listed. Optional accessories, for angle cutting and repetitive cutting, have been included. **7**

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SET-SCREW DRIVER—Standard Pressed Steel Co., Jenkintown, Pa. Bulletin describing performance of a new automatic set-screw driving device, called "Setomatic." It provides close-ups of feed and drive mechanisms, and diagrams three modes of operation of the device. Overall dimensions, basic engineering specifications, and major features of operation and application are given. **8**

FLAME-CUTTING MACHINE—Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City. Booklet detailing the features of "Airco's" No. 20 "Radiagraph" flame-cutting machine. The Radiagraph is a portable, motor-driven, straightline track-guided machine. Limited contour, circular, and curved cutting can be accomplished by using suitable accessories, which are also described in the booklet. **9**

MACHINE TOOL MOUNTINGS—Korfund Co., Inc., Long Island City, N. Y. Bulletin E6B, giving application data for machine tool mountings that simplify installations and increase production. It tells how to determine if steel springs, rubber, or cork should be used as machine mountings, and how to determine the size and quantity of those needed. **10**

TUBE MILLS—The Yoder Co., Cleveland, Ohio. 64-page illustrated handbook, "Electric Resistance Weld Tube Mills." The booklet provides a step-by-step description of the electric-weld process from roll-forming and shaping of the tube to the finished product. Photographs, drawings, and charts illustrate the operation, capacity, and application of various-sized electric-weld tube mills. **11**

SILICONES—Silicones Division, Union Carbide Corporation, New York City. Data Sheet SF-1128, outlining the use of Union Carbide silicones in the shell-molding industry. It describes the properties, advantages, and effective working concentrations of three Union Carbide silicone parting agents, LE-460 Silicone Emulsion, LS-46 Silicone Solution, and L-46 Silicone Oil. **12**

CUTTING AND GRINDING FLUIDS—Keystone Lubricating Co., Philadelphia, Pa. Bulletin No. BK-21, two-color booklet describing Keystone's complete line of cutting and grinding fluids for the metal-working industry. The line includes six specialized products—three oil type and three water type lubricant-coolants for virtually every metal-removal need. . . **13**

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MULTIPLE-SPINDLE BAR AUTOMATIC—National Acme Co., Cleveland, Ohio. Bulletin MRA-58, illustrating the company's newest and smallest Acme-Gridley multiple-spindle bar automatic, the 7/16 inch RA-6. The bulletin lists and shows design and construction features and standard accessory attachments for threading and tapping, high-speed drilling, back-finishing, etc. **14**

COLD-FINISHED BARS—Joseph T. Ryerson & Son, Inc., Chicago, Ill. Bulletin No. 12-5, serving as a simplified guide to selection and specification of cold-finished carbon-steel bars. It lists twenty-three different types. Information on mechanical properties, formability, weldability, heat-treatment response, machinability, and size range is included. **15**

PUMPS—Oilgear Co., Milwaukee, Wis. Bulletin No. 47550, covering the company's new "Power Saver" pump. An integral, infinitely adjustable, pressure unloading control with a range of 200-1100 psi, and adjustable volumes up to 3100 cubic inches per minute are features. The bulletin is illustrated with photos and dimensioned drawings of both clockwise and counterclockwise pumps, adapter and angle bracket mountings, and a standard reservoir base (with pump and motor mounting). **16**

FLEXIBLE AUTOMATION — General Electric Co., Schenectady, N. Y. Bulletin GED-3684, defining "Flexible Automation" as use of numerically controlled machines to make possible the economic production of job-lot orders and prototype development. Actual case histories are cited showing reductions in production time and increases in accuracy and machine flexibility. **17**

INSPECTION EQUIPMENT AND SPINDLES—Bryant Gage & Spindle Division of Bryant Chucking Grinder Co., Springfield, Vt. Booklet incorporating information about gages, surface plates, spindles, and magnetic drums for computers. Lists of dealers and detailed descriptions are included, with illustrations. **18**

PRESSES—Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. Bulletin 1055-A, giving description and specifications on Elmes hydraulic forcing presses, vertical and horizontal types. Handy chart is provided for use in making rough preliminary calculation of force required to press a steel shaft into a steel hub. **19**

VALVES—Ohio Injector Co., Wadsworth, Ohio. 28-page catalogue listing over 95 per cent of the line. Valve figure numbers are indexed for finger-tip reference by topics; face-to-face dimensions are supplied in full-size ranges. A valve comparison chart offers a quick cross-reference to the most commonly used figure numbers of ten valve manufacturers. **20**

INDUCTION HEATING—Magnethermic Corporation, Youngstown, Ohio. Bulletin HF-58-6, describing high-frequency induction-heating equipment. It includes information on heat stations and generator control units; application photos and data on heat-treating, annealing, brazing, forging, shrink fitting; data on vertical motor-generator sets, etc. . . . **21**

FURNACES—C. I. Hayes, Inc., Cranston, R. I. Bulletin No. 463, describing complete line of high-temperature pusher

furnaces. These furnaces are offered in three styles: (1) with open chamber and exposed heating elements, (2) with refractory muffle, and (3) with metallic muffle. **22**

CUTTING TORCHES—Linde Co., Division of Union Carbide Corporation, New York City. Folder, Form 1174, presenting a complete line of Oxweld flame-cutting equipment. Torches that can be used interchangeably with every fuel gas combination—oxy-acetylene, oxy-propane, and oxy-natural gas—are described. **23**

ELECTRODES—A. O. Smith Corporation, Welding Products Division, Milwaukee, Wis. Bulletin No. MW-222, outlining data on more than twenty-five different electrodes and wires. It contains a "checklist of uses," a handy guide for selecting the correct electrode or wire to use on more than four hundred different types of welding equipment. **24**

SWITCHES—Micro Switch, a Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. 32-page edition of its basic Switch Catalogue No. 62c, presenting innovations in basic switches for industrial and commercial applications. Among the new switches are the high-precision roller lever switch, the adjustable actuator switch, and the "pulse" switch. **25**

DIAMOND WHEELS—Diacraft, Inc., Detroit 40, Mich. Catalogue announcing the new metallic- and resinoid-bonded, diamond grinding wheels. Diacraft wheels are made in all the customary shapes and sizes for carbide grinding as well as custom-made wheels for special applications. **26**

CRYOGENIC REFRIGERATOR—Linde Co., New York City. Folder No. F. 1059A, presenting the new Linde LNR-25B liquid-nitrogen refrigerator. The LNR-25B is ideal for the storage of medical and biological specimens, chemicals, and metallurgical samples, and for shrink-fitting small metal production parts. **27**

ROTOR MOTORS—General Electric Co., Schenectady, New York. Bulletin GEA-6713, describing the company's "Tri-Clad" 55 A-C wound-rotor motors for either crane or general industrial applications. Available from 5 through 150 hp with adjustable varying speed. Cutaway view shows internal construction. Ratings and dimensions are given. . . **28**

BORING MILLS—Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. Bulletin 1157, describing 4- and 5-inch table type, horizontal boring, drilling, and milling machines. Pendent control and other design features are summarized and illustrated. Specifications are included. **29**

LUBRICANTS — Keystone Lubricating Co., Philadelphia, Pa. Bulletin BK-19-a, entitled "Keystone Planned Lubrication." It provides a pre-tested, pre-established list of correct lubricants for a number of specific types of equipment operating under normal conditions of speed and temperature. **30**

INDUCTION HEATING—Sylvania Electric Products, Inc., Buffalo, N. Y. Booklet entitled "R-F Induction Heating," describing the characteristics and functions of a wide variety of power tubes in R-F induction heaters. **31**

INVESTMENT CASTINGS—Mercast Mfg. Corporation, La Verne, Calif. Booklet entitled "How To Buy Investment Castings." The text points out significant evalution factors for judging investment castings and selecting supplies. **32**

CIRCUITS—Logansport Machine Co., Inc., Logansport, Ind. 28-page booklet originally presented in 1952, which has been completely revised to meet new requirements in the fluid-power field. The air and hydraulic circuits shown have been field-tested. **33**

HYDRAULIC PRESS BRAKES—The Cleveland Crane & Engineering Co., Wickliffe, Ohio. Catalogue No. 2024A, describing the new line of Steelweld hydraulic press brakes. It gives construction details and specifications. **34**

BAND SAW—W. Whitney Stueck, Inc., Old Saybrook, Conn. Folder presenting company's Connecticut band saw. The folder fully describes its ability to perform both low-speed sawing and high-speed friction cutting as well. **35**

WORM-GEARS—Cleveland Worm & Gear Co., Cleveland, Ohio. Bulletin No. 150, providing information on worm-gearing. It points out the advantages of this type of gearing and gives pertinent design and manufacturing facts. . . . **36**

WELDER—Wall Colmonoy Corporation, Detroit, Mich. Brochure describing the "Colmonoy" semi-automatic welder. It illustrates major construction features of the new welder and lists a wide variety of typical applications in representative industries. **37**

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HYDRAULIC PRESSES—Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. Bulletin 1015, giving full description and specifications on Elmes hydraulic C-Frame presses for forcing, straightening, bending, forming, and similar operations. **38**

TWIST DRILLS AND TOOLS—Precision Twist Drill & Machine Co., Crystal Lake, Ill. 40-page catalogue No. C-58, introducing Precision's carbide and carbide-tipped drill and reamer line. The company has been specializing in the manufacture of drills as small as .0059 diameter. **39**

PRESS BRAKES—Taylor-Winfield Corporation, Warren, Ohio. Bulletin No. 13-693, presenting the firm's line of press brakes. It gives complete specifications and the force required to bend mild steel with standard air-bend dies. **40**

MILLING TECHNIQUES — Precision Shapes, Inc., Suffern, N. Y. Booklet presenting a unique, continuous milling process and a new sculpture-milling technique with scores of application in the aircraft and missiles industry, as well as in the production of other industrial equipment. **41**

COIL SPRINGS—Crucible Steel Company of America, Pittsburgh, Pa. 48-page illustrated handbook including mathematical data and charts. It reviews Crucible's facilities and experience in the manufacture of heavy-duty industrial springs. **42**

HYDRAULIC PUMPS—SC Hydraulic Engineering Corporation, Los Angeles, Calif. Folder describing in detail a new 10-500 series of air-operated hydraulic pumps. They are available in nine sizes, capable of producing from 500 to 25,000 psi hydraulic pressure from a maximum of 100 psi air pressure. **43**

LAYOUT MACHINE — Portage Double-Quick, Inc., Akron, Ohio. Brochure outlining layout technique. Specifications for a machine table and table base for a layout machine are given. **44**

CARBIDE THROWAWAY INSERTS—Pratt & Whitney Co., Inc., West Hartford, Conn. Circular featuring applications of two types of throwaway inserts. **45**

AUTOMATIC POINTING MACHINE—Economy Engineering Co., Willoughby, Ohio. Two circulars feature one Type 4600 and two Type 3300 machines. These are especially adapted for large and small work. **46**

PRECISION FINISHING—Techline Division, Wheelabrator Corporation, Vicksburg, Mich. Bulletin 100, featuring precision finishing by the wet-blasting method. **47**

CHUCK JAWS — Rolls-Harriman Inc., Harriman, N. Y. Circular introducing a new range of soft, blank top jaws for all chucks with American Standard master jaws. **48**

AUTOMATIC SHAVING MACHINE — Economy Engineering Co., Willoughby, Ohio. Circular describing Type "S"-4300, a fully automatic shaving machine with high-production rates. **49**

ADJUSTABLE SPEED DRIVES—Cutler-Hammer, Inc., Milwaukee, Wis. Booklet EN-64, presenting "Ultraflex E" electronic packaged drive. Applications in automated systems or with non-related drives are described. **50**

CUT-OFF WHEELS—Peninsular Grinding Wheel Division, Detroit, Mich. Folder describing a variety of cut-off wheels and giving specification data. **51**

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to 50 can be inspected with a standard set of gaging points. The surface finish of tooth flanks can also be checked and recorded with a knife-edge gaging point.

Circle Item 133 on postcard, page 201

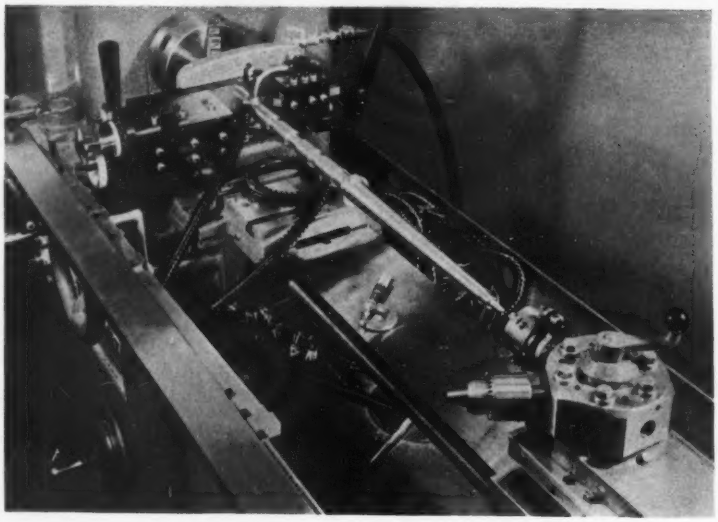
Zagar Adjustable-Spindle Drill Head

An adjustable multiple-spindle drilling head, built on the Zagar gearless-head principle, has been brought out by Zagar, Inc., Cleveland, Ohio. These heads are designed to accommodate from two to ten spindles in sizes of 7, 10 1/2, 12 1/2, and 15 1/2 inches. Bolt circles up to 23 inches in diameter allow almost any hole pattern to be drilled or tapped within a given circle. Additional spindles (within limitation) can be furnished at nominal cost.

The spindles are driven by a crank type drive-shaft. The shaft of each spindle is driven by the standard Zagar method used on gearless drill heads of close center design. Ball bearings and bronze bearing bushings are used throughout. Spindle arms can be removed and replaced quickly, using two locking set-screws. The head, which can be used on any standard drill press, is made as a complete unit, no auxiliary equipment being needed.

Circle Item 134 on postcard, page 201

Zagar adjustable-spindle drill head



Karge Turnomat automatic centerless contour-turning machine

Automatic Centerless Turning Machine

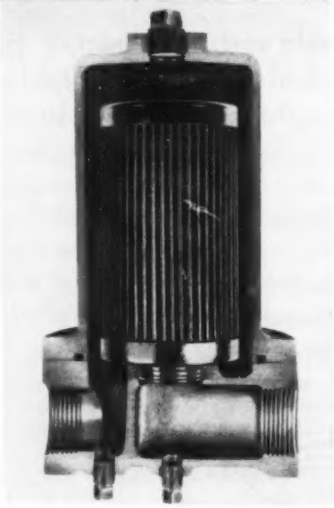
A multiple-purpose, precision, centerless lathe for fast, single-pass, plunge-cut turning of all types of metals, plastics, etc., has been introduced by the Taber Instrument Corporation, North Tonawanda, N. Y. The turning operation is performed on this Karge "Turnomat" contour lathe without the support of headstock and tailstock centers or steadyrests. The traveling Turnomat spindle collet and single-point tool, moving along the bar stock as a unit, can automatically produce workpieces of infinite lengths, tapers, and contours with a fine machine finish. Accuracy is held within a tolerance of 0.0005 inch or better. Long or short runs of parts are economically handled with a minimum expenditure for tooling because all turning operations are accomplished with the same single-point cutting tool.

Circle Item 135 on postcard, page 201

Marvel Line Type Filter

A line type filter for installation on suction or return lines, which is said to offer many advantages in the filtration of hydraulic oils, fire-resistant fluids, coolants, and lubricants, has been brought out by the Marvel Engineering Co., Chicago, Ill. This filter is designed for operating pressures up to 150 psi at temperatures up to 300 degrees F. It is now being produced in capacity sizes of 10, 20, 30, 50, and 75 gallons per minute, with Monel wire cloth mesh sizes from 30 to 100. All units are available with or without a by-pass valve.

Ample filtering area provides long periods of productive operation and dependable protection on all hydraulic and other low-pressure liquid circulating systems at a minimum of down time for maintenance. Provision is made for installation of either a vacuum



Marvel line type hydraulic filter for suction or return lines

or pressure gage, or both. All units are easily disassembled for thorough cleaning. No "throw-away" or replacement parts are used.

Circle Item 136 on postcard, page 201

Low-Priced Metal-Cutting Band Machines

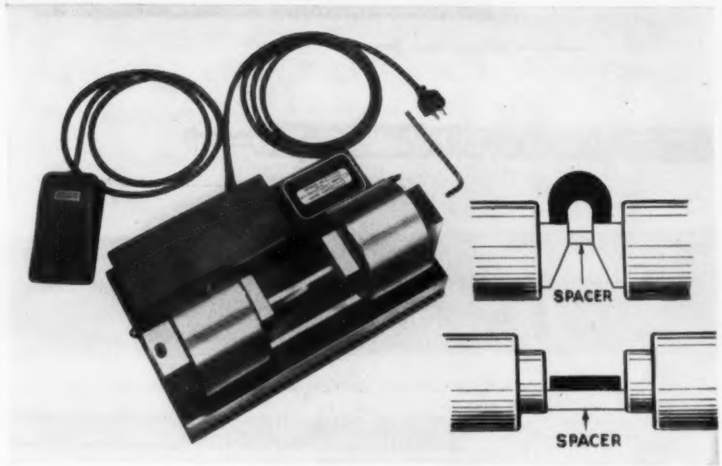
The DoALL Co., Des Plaines, Ill., has developed a line of 16- and 30-inch machines in response to the demand for lower-priced, metal-cutting, contour band machines for toolrooms, jobbing, sheet-metal, and maintenance shops. These Model 16M and 30M band machines combine the compact, flexible design of the earlier SFP series with the power, rigidity, and stamina of the standard, heavy-duty contour line.

A new Speedmaster variable-speed 1-hp drive delivers full power to the cut throughout the entire 50- to 5200-feet-per-minute band speed range. This wide range permits the machines to contour-saw any machinable material as well as band file, band-polish and friction-saw thin, ferrous work. The work-table surface is ground for accuracy and etched to eliminate eye strain. The start-stop switch, feed, speed change, and band-tension handwheels as well as the band-tension indicator are positioned for operator convenience.

A built-in band shear and welder permit internal cutting. The new powerful work light and low reflective table surface facilitate close work without eyestrain.

Circle Item 137 on postcard, page 201

DoALL low-priced contour band machine



General Electric magnetizer for processing permanent magnets

Welding Anode Container

Hang-up of anodes employed in plating operations is said to be completely eliminated through the use of a new type anode container, developed recently by the Equipment Division of Wagner Brothers, Inc., Detroit, Mich. The new container of welded construction is of the "basket" type with its vertical members and supporting rings arranged to provide maximum weight distribution in supporting the heavy metal-anode loads.

Other construction features of the container include double spacing of vertical members at the lower portion of the unit, and reinforced bottom. The container bottom is reinforced both by an extra-heavy steel ring and an angle type spine which bends under the bottom and runs the full length of the container, to end up as a hook at the top. The container is manufactured in lengths to meet each user's requirements, and in standard diameters of 2 1/4 inches. It also is produced with double hooks of 3/8-inch square bar stock with knife-edge contacts.

Circle Item 138 on postcard, page 201

GE Self-Contained Magnetizing Units

Two completely self-contained units for magnetizing permanent magnets that can be plugged into any 115-volt alternating-current outlet are being manufactured by General Electric Co.'s Magnetic Materials Section, Edmore, Mich. Magnetizing coils and silicon rectifier are combined in one unit in both the light-duty Model MF-200 and medium-duty Model MF-300. These small units can be readily moved, yet they are flexible and powerful enough to be used with all permanent-magnet alloys. Reserve capacity is provided for use in the event that still more powerful magnetic materials may require processing. Equipment includes a foot switch and pole pieces—round pole pieces for use with bar magnets and tapered ones designed for use with horseshoe magnets.

In operation, the pole pieces are attached and the sliding right-hand coil adjusted to the proper air-gap position. The magnet to be magnetized is then simply placed into the air gap and the foot switch pressed for a second or two.

The MF-300 magnetizer is 14 inches wide, 24 inches long, 8 inches high, and weighs 150 pounds. It will magnetize magnets up to 8 inches long (or up to 7 square inches cross-sectional area).

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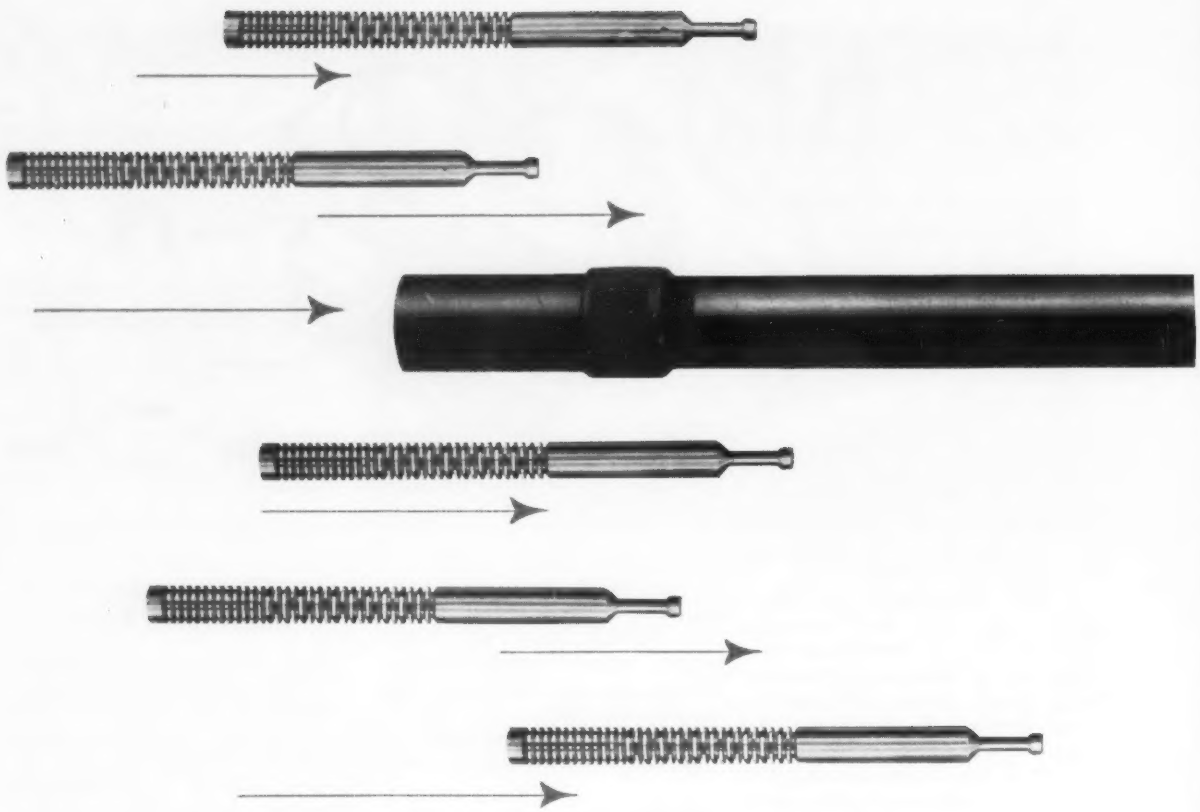
(This section continued on page 210)



CP PORTABLE ...A NEW WAY

Now you can take a 9-pound portable hydraulic tool to the work and finish round holes to tolerances as close as .0002″ in a matter of seconds. This new and highly productive method is preferred over reaming because of its greater accuracy and lower labor and tooling costs. Round holes *are really* round and meet every standard for size, concentricity, squareness of bore axis with face, absence of taper, and bell mouth. In addition, round pilot holes are quickly converted to square, hex, oval, splined or keyed shapes . . . and hole walls are "mirror finished". Capacity: 3/16″ to 5/8″ diameter holes.

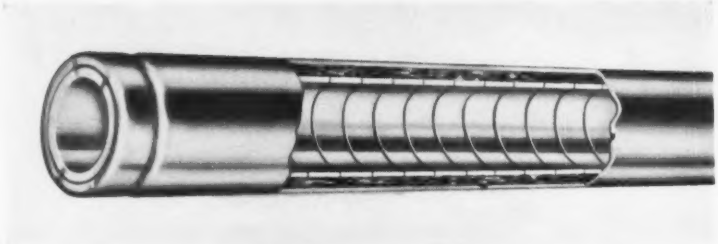
For more info on any products advertised this issue use card, page 201

Silent Stock Tubes

The Brown & Sharpe Mfg. Co., Providence, R. I., has brought out a line of silent stock tubes for its automatic and hand screw machines. The line includes seven sizes which accomodate round, hexagonal, square, or irregular-shaped bar stock in sizes ranging from 1/2 inch to 1 1/2 inches.

The bar rotates in a helically wound, wear-resistant steel liner having no sharp edges to damage the stock. The liner also serves to eliminate objectionable noise created by the rotation of the stock in the tube. Stock of either round or irregular cross-section is handled without marring. This is an important advantage, especially where the bar being used is an expensive extruded shape.

Circle Item 140 on postcard, page 201



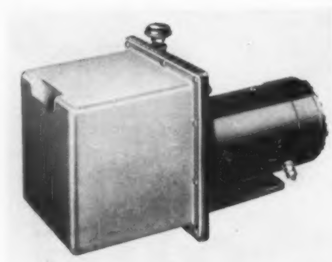
Brown & Sharpe silent stock tube for automatic and hand screw machines

Micrometer with Window-Reading Feature

A window-reading micrometer of West German make is being introduced in this country by Opto-Metric Tools, Inc., New York City. In this micrometer the "quarter" divisions of 25, 50, and 75, usually found on the sleeve, have been eliminated. Instead, the sleeve bears only 0.1-inch graduations. The 0.01-inch graduations are read through the windows numbered 0 to 9, while the 0.001-inch values appear on the thimble, opposite the 0.0001-inch vernier, but flush with each other. The reading in the illustration thus would be: on the sleeve 0.3; in the window 0.07; on the thimble 0.002; and on the vernier 0.0003 inch. The total of 0.3723 inch is the correct reading. Thus the instrument is truly decimal or digital, requires no other computation, and is continuous-reading. Another advantage claimed for this micrometer is that the flush reading for the second, third, and fourth digits is completely free of parallax.

Circle Item 141 on postcard, page 201

Window-reading micrometer introduced by Opto-Metric Tools, Inc.



Self-contained hydraulic unit made by the John S. Barnes Corporation

Barnes Self-Contained Hydraulic Unit

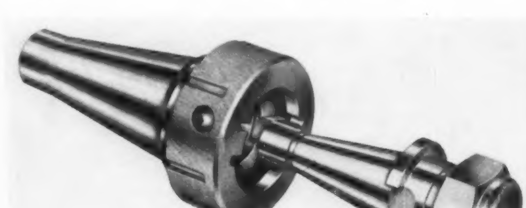
A self-contained hydraulic unit available in countless variations incorporating standard pumps, motors, valves, and reservoirs can be furnished by the John S. Barnes Corporation, Rockford, Ill. Units like the one shown can be made in capacities of 1/2 to 4 gallons per minute at 1800 rpm with pressures up to 2000 psi. Increased delivery capacities can be obtained at 3600 rpm. Pumps can be supplied with any or all of the following built-in features—check-valve, relief-valve, and manual- or solenoid-operated lowering valves.

Direct or belt drives with air-motors or other special drives for volume applications can be supplied. Motors for continuous or intermittent duty are available. Standard alternating-current electric motors from 1/4 hp through 2 hp in special-duty ratings as well as explosion-proof styles can be furnished. Direct-current motors operating on 6, 12, and 24 volts can also be supplied. Applications include dock-leveling devices, tractors, lift trucks, and many others where a low-cost, high-quality, lightweight unit is required.

Circle Item 142 on postcard, page 201

Erickson Quick-Change Tool-Holder

A line of patented quick-change tool-holders for drilling, boring, milling, reaming, tapping, and other machining operations is being manufactured by the Erick-



Quick-change tool-holder of line announced by the Erickson Tool Co.

son Tool Co., Solon, Ohio. All present standard MMS tapered tools can be used with these quick-change holders, thus giving the user the double advantages of high precision with the rapid tool-changing feature. A simple grinding operation makes present adapters suitable for use with the quick-change holders.

Seven distinct models, each in several size ranges, comprise the line of quick-change holders. These are: Morse taper holders for boring mills and radial drills, milling-machine holders that fit standard spindle tapers, turret lathe holders that increase turret lathe tool-holding capacity, straight shank holders with No. 30 or No. 40 MMS socket, Erickson collet chuck milling machine adapters in both regular and heavy-duty types, end-mill adapters, shell- and face-mill adapters, Morse taper adapters, boring-head adapters, and chuck adapters for Jacobs internal taper.

Circle Item 143 on postcard, page 201

"Syncro-Spede" Motor

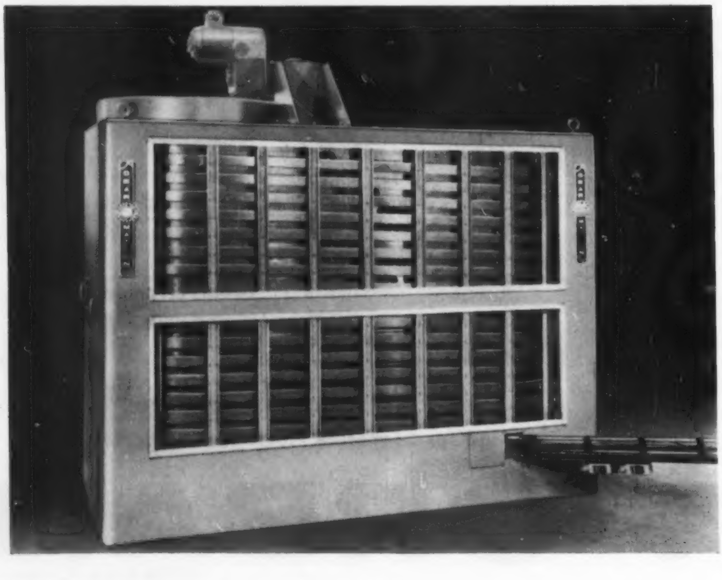
Synchronous induction motor built in the same NEMA frame size as a standard motor of equal horsepower, recently announced by the Louis Allis Co., Milwaukee, Wis. Called the "Syncro-Spede," it accelerates as an induction motor but runs at exact synchronous speed without permanent magnets or direct-current excitation involving collector rings and brushes, wound rotating fields, etc. It is claimed to be the most compact alternating-current motor available for synchronous applications and offers the highest power factor and efficiency. It is suitable for use on many applications requiring constant speed with varying load. Syncro-Spede motors can be used for constant speed drives in the machine tool, synthetic fiber, plastic, paper, wire-drawing, glass-making, and printing industries. Because of its size it can provide precise frequency systems in small generator ratings. These motors are now manufactured in ratings from 1 to 100 hp in any enclosure type and can be foot- or flange-mounted. They are designed for horizontal or vertical mounting to suit many requirements.

Circle Item 145 on postcard, page 201

Parts-Storage Unit with High-Capacity Automatic-Demand Feeding

Storage unit for parts that can roll, developed by the Gear-O-Mation Division of Michigan Tool Co., Detroit, Mich. Designed for use in automated production, the equipment offers a true-demand feeding system from mobile storage. Parts are moved through the unit from motion imparted from a double rubber belt rotating laterally within the unit. They enter the unit at the lower front end and leave at the top. Capacity is 2500 gear blanks 2 inches in outside diameter.

Circle Item 144 on postcard, page 201

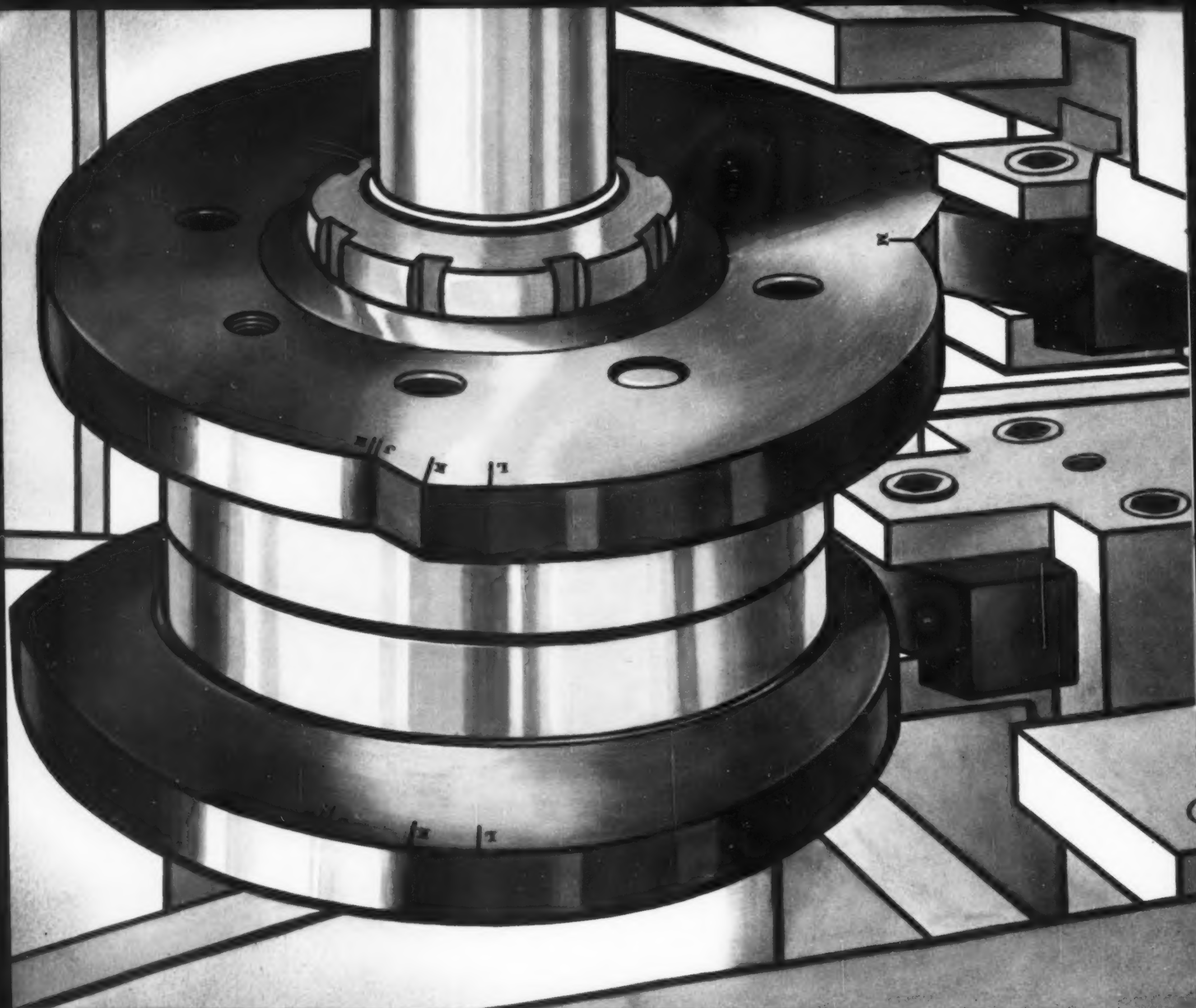


Racine Portable Power Hammer

Lightweight portable power hammer designed to handle a wide range of work marketed by Racine Hydraulics & Machinery, Inc., Machinery Division, Racine, Wis. The 60-pound power hammer is driven by a 1 1/2-hp, two-cycle air-cooled gasoline engine. A new driving principle, creating a high velocity blow through a spring-and-crank assembly, furnishes 1500 blows per minute with less wear on tools than the direct-connected type of hammer. A quick-opening tool chuck permits changing tools in fifteen seconds.

Circle Item 146 on postcard, page 201

(This section continued on page 215)



Fin-Cooled Speed Reducers

The Ohio Gear Co., Cleveland, Ohio, has announced the introduction of three new fin-cooled speed reducers designated the Series "20" line. These single worm-gear reduction, right-angle drive units include both horizontal and vertical output shaft models. Completely redesigned, with new, heavier housings, heavy-duty anti-friction bearings, and precision worms and gears. Designed for use with motors up to 1.5 hp.

Circle Item 147 on postcard, page 201

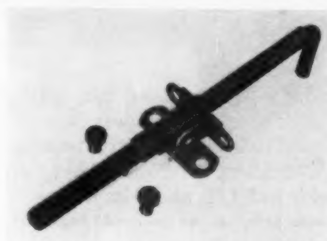
South Bend Non-Glare Graduated Collars

Non-glare, satin-finish chromium, graduated collar (top view) now standard equipment on all 10-inch and larger lathes built by the South Bend Lathe Works, South Bend, Ind. The reproductions of two unretouched photographs here illustrated show dramatically the difference in the light-reflecting characteristics of the new satin-finish and old polished-steel collars. Graduations on the new collar are deep-cut and will not wear off. The satin-finish chromium surface provides a broad highlight in which the jet-black graduations stand out clearly under any kind of illumination. Easy to read, they reduce operator fatigue and permit adjusting the position of the cutting tool quickly and accurately.

Circle Item 148 on postcard, page 201

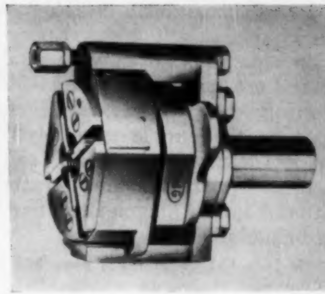
Danly Automatic Die Stop

Automatic die stop equipped with brackets that permit mounting on either the top or front of a die announced by Danly Machine Spe-



cialties, Inc., Chicago, Ill. This stop can be installed in ten or fifteen minutes. It is made in three sizes: 3/16 inch by 5 inches, 1/4 inch by 6 inches, and 3/8 inch by 9 inches. It provides a completely automatic method for stopping stock at the proper index during strip- or coil-fed stamping.

Circle Item 149 on postcard, page 201



Self-Opening Die-Head

Thread-cutting, self-opening, "H & G" aluminum die-head of new line announced by the Eastern Machine Screw Corporation, New Haven, Conn. The die-heads of this line are made from a special alloy of aluminum and given a special surface treatment. Their advantage of being lighter in weight for a given capacity is an important factor in obtaining operating efficiency on the new high-speed, fast-indexing machines. These lightweight die-heads, for example, are said to greatly reduce the wear and vibration on the turret-indexing mechanisms. Another advantage is that chaser life and thread quality are improved. At present these die-heads are made in Size 00, Style DMLN (alignment) type with a 7/16-inch normal capacity.

Circle Item 150 on postcard, page 201

Hanchett Magnetic Chuck

Fine-grid magnetic chuck made by the Hanchett Magna-Lock Corporation, Big Rapids, Mich. This chuck has precision-meshed magnetic poles which are said to be 37 per cent closer together than in conventional chucks of this type. It is claimed that the resulting powerful magnetic pull will hold small parts firmly in place while they are being machined. The magnetic poles are of 3/8-inch steel separated by 1/8-inch non-magnetic separators of CRP-

242 hard epoxy resin or "Magna-Lock" special soft metal. Epoxy-resin separators are easy to grind in and are particularly suited for electrolytic grinding operations because they resist electrolytic action. Magna-Lock special soft metal is available as an alternate material for all Magna-Lock fine-grid chucks.

Circle Item 151 on postcard, page 201

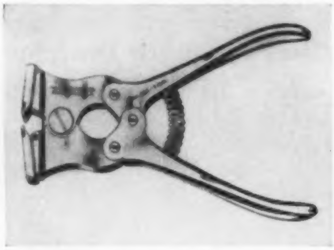
Lovejoy Shaft-Mounted Gear Reducer

Shaft-mounted gear reducer that eliminates the need for motor bases, rails, supporting structures, and flexible couplings now available from the Lovejoy Flexible Coupling Co., Chicago, Ill. This equipment is designed to provide a compact, space-saving, power-transmission unit for a wide range of industrial applications. It eliminates alignment problems, and makes possible infinite-speed ratios through the use of variable-speed pulleys or by changing sheaves, sprockets, or prime-mover speed. Proper belt tension between drive and driven unit is maintained by simple adjustment of the rod and turnbuckle. Eighteen models, including single- and double-reduction types, can be supplied from stock. Single-reduction types are 98 per cent efficient and double-reduction types, 96 per cent efficient. Horsepowers range from fractional to 120, and output speeds, from 8 to 425 rpm.

Circle Item 152 on postcard, page 201

Starrett Adjustable-Jaw Cut Nippers

Cut nippers with jaws that can be removed, reground, adjusted, or replaced now offered with tungsten-carbide tips for extra long life by the L. S. Starrett Co., Athol, Mass. Available as No. 1X for cutting wire, and as No. 235X with



wider opening jaws for cutting tile. These cut nippers are designed to insure powerful leverage for efficient cutting. They are made in 5 1/2- and 7-inch sizes.

Circle Item 153 on postcard, page 201

Milling Spindle Conversion Unit

Extra heavy-duty precision milling spindle with through hole for draw-bar, equipped with a No. 50

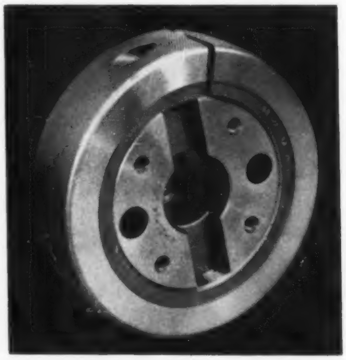
NMTB spindle nose, built by the Standard Electrical Tool Co., Cincinnati, Ohio. The integral geared transmission, as illustrated, is assembled with a 2 to 1 or 1 to 2 ratio timer-belt drive with conventional precision power motor of selected horsepower. An infinitely variable frequency changer gives a stepless speed range from 100 to 1000 rpm.

Circle Item 154 on postcard, page 201

Carbide-Tipped, Shell Type Expansion Reamer

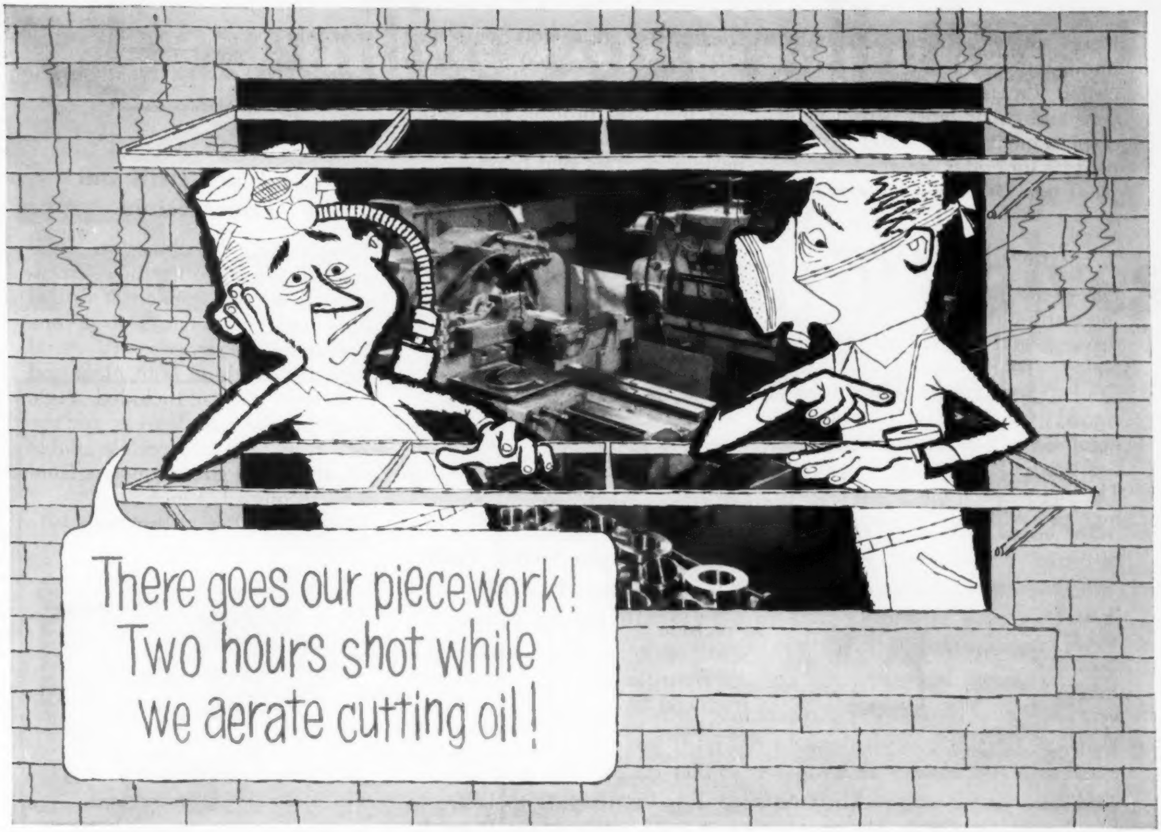
Carbide-tipped, shell type expansion chucking reamer available with either straight or taper shank from National Twist Drill & Tool Co., Rochester, Mich. This reamer is designed for use in the mass production of parts having close-tolerance holes. The shell can be accurately expanded to compensate for wear and, when worn undersize in the fully expanded state, it can be easily replaced. The grooved rear pilot makes it possible to use this reamer either with or without guide bushings.

Circle Item 155 on postcard, page 201



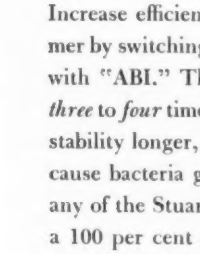
Micro-Adapter Designed to Compensate for Cutter Wear

One of a line of precision "Rigid-cut" milling-cutter micro-adapters brought out by the Wesson Co., Detroit, Mich., to eliminate the need for expensive, adjustable milling machine spindles when the adapters are specified as original machine tooling. With normal face-milling cutter wear up to 0.020 inch, these adjustable adapters permit four regrinds before blades must be reset. Adapter adjustments are made in the toolroom at the time of grinding so that machine down time is minimized. External adjusting collar



Now...prevent "Monday Morning Odor" with Stuart's SOLUBLE OILS, fortified against rancidity!

Increase efficiency after weekend and vacation shutdowns this summer by switching to a Stuart water-mix cutting or grinding compound with "ABI." These compounds are GUARANTEED to stay sweet *three* to *four* times longer than other water mixtures. They retain their stability longer, too, giving you more pieceparts per tank change because bacteria growth is positively inhibited. You are invited to try any of the Stuart top-quality, heavy-duty soluble oils listed below on a 100 per cent moneyback basis. Phone your Stuart service center (at the right) for a test sample before "Monday morning odor" hits your plant for another efficiency loss.



WRITE FOR NEW FREE BOOKLET

Learn about Stuart's new low-cost, heavy-duty soluble oil for both cutting and grinding. Dasco D-20 has both EP and "ABI" (anaerobic bacterial inhibitor) at no extra cost. Booklet shows outstanding results with Dasco D-20 on a variety of machining operations.

SERVICE LIFE GUARANTEE

Stuart guarantees, on a moneyback basis, your complete satisfaction with the bacteria resistance of the compounds listed at the bottom of the page. Phone for a test sample today!

BAYONNE, N.J.	Hemlock 7-0151
CHICAGO, ILL.	Bishop 7-7100
CLEVELAND, OHIO	Prospect 1-7411
DETROIT, MICH.	Tyler 7-8500
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METALWORKING LUBRICANTS

SOLVOL "X" • DASCO D-20

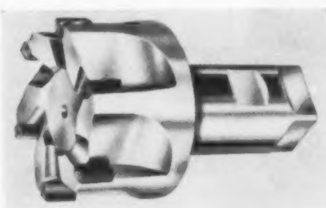
CODOL "X" • DASCO SUPER-SOLUBLE "X" BASE

rests against the machine spindle, imparting face squareness to the cutter. Precision threads on the core and collar units permit axial displacement of the cutter to compensate for cutter wear.

Circle Item 156 on postcard, page 201

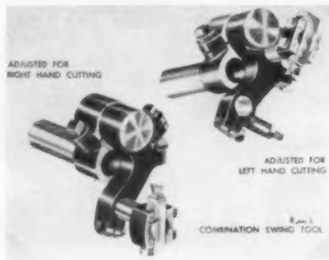
Nelco Facing Cutter

One-piece face-milling cutter having a straight shank with a square driving end developed by the Nelco Tool Co., Manchester, Conn. This cutter is primarily designed for use in automation equipment where positive and repetitive location is required. The shank has a fine pitch thread for pre-setting the adjustable



stop for depth of cut. The shank also has flats for set-screw clamping that make it possible to mount the cutter in the standard 50-2 straight-shank adapter. Solid carbide tips are sandwich-brazed to a steel body with integral straight steel shank having a 45-degree chamfer. Available in four series: Series 100 for milling alloy steel; Series 200 for milling mild steel; Series 300 for milling cast iron and bronze; and Series 400 for milling aluminum, magnesium, plastics, and brass.

Circle Item 157 on postcard, page 201



Combination Swing Tool for Turret Lathes

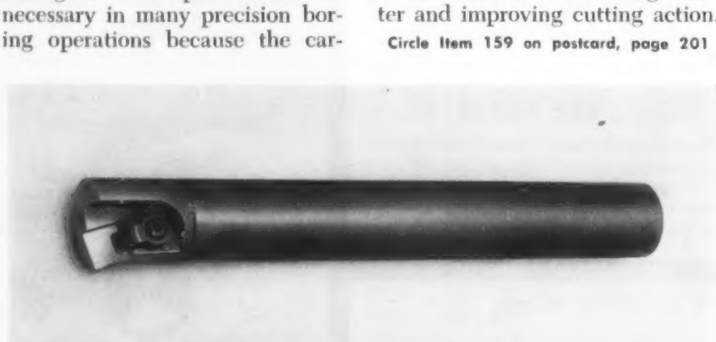
Precision tool for turret lathes and screw machines which is adaptable for right- or left-hand cutting, introduced by R and L Tools, Philadelphia, Pa. This combination swing tool is designed to permit straight, taper, or irregular turning when cross-slide tools are in use for other operations. It can be easily changed for right- or left-hand cutting by moving the holder from one location to the other (see illustrations) and using the required blade. Two high-speed cutting tools are furnished with the unit.

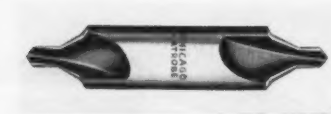
Circle Item 158 on postcard, page 201

Kennametal Carbide-Encased Boring-Bar with Throw-Away Carbide-Insert Tools

Carbide-encased boring-bar with throw-away carbide-insert tool brought out by Kennametal, Inc., Latrobe, Pa. Utilization of this boring-bar makes piloted bars unnecessary in many precision boring operations because the carbide sleeve greatly increases the stiffness of the bar. Tests have shown that the core of softer material in these bars sometimes has been beneficial in reducing chatter and improving cutting action.

Circle Item 159 on postcard, page 201





Combined Drill and Countersink

Double-end combination tool made by Chicago-Latrobe, Chicago, Ill., which produces a drilled hole and countersinks it in one operation. Designed with spiral flute and made in both plain and bell type points. Included angle of plain type is 60 degrees, and the bell type, 120 degrees. Available in sets and in size diameters from 3/64 through 1/4 inch.

Circle Item 160 on postcard, page 201

Thor Air-Impact Wrench

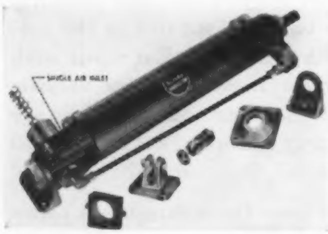
Compact, lightweight, yet powerful Model 024 air-impact wrench with 1/2-inch drive introduced for industrial use by Thor Power Tool Co., Chicago, Ill. New features include: simplified impact mechanism with only four moving parts, no springs or gears, and unitized construction for easy removal and inspection of parts, and needle-bearing design for impact spindle rotation that provides longer service and lower maintenance costs. The wrench weighs 6 3/8 pounds and is only 6 9/16 inches long. An extra-large air motor, operating at 6000 rpm free speed, and an exceptionally compact impact mechanism make this a hard-hitting and fast-driving impact wrench. It is designed especially to handle 3/8-inch bolts.

Circle Item 161 on postcard, page 201

(This section continued on page 220)

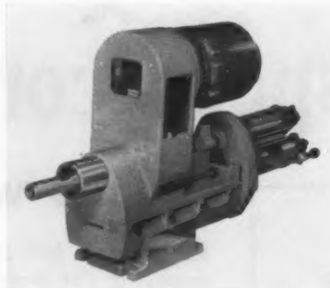
Automatic-Return Cylinders

Four new lines of automatic-return and a new line of automatically reciprocating air cylinders have been added to the "AllenAir" line of power cylinders made by the A. K. Allen Co., Inc., Mineola, N. Y. The automatic-return cylinders are available for single control either by electric switch or bleeder valve and come with rods either normally retracted or extended. The advantage of these new units is that the separate return-controlling units previously mounted outside of the cylinders



have been designed as an integral part of the cylinder heads, so that a single actuation of the single control sends the rod to full stroke. The rod then returns automatically upon reaching the end of its stroke. The electric Model VER is available for either 8-, 110-, or 220-volt operations. All models come in 1 1/2-, 2-, 2 1/2-, 3-, and 4-inch bore sizes. The automatically reciprocating ones require but one air connection to the cylinder-valve unit and are controlled by a standard shut-off valve.

Circle Item 162 on postcard, page 201



Gotha Air Hydraulic Drilling Unit

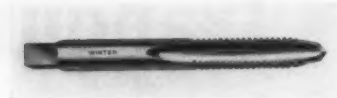
Automatic drilling unit developed by Gotha, Inc., Harvey, Ill., for use in the metalworking field where high production and low unit cost are essential. This self-contained automation unit, on receiving a small, momentary, electric impulse, will perform a complete machining cycle consisting of drilling, reaming, counterboring, spot-facing, or tapping. Tapping may be done by the addition of a tapping head or by a slight modification of the standard unit.

Circle Item 163 on postcard, page 201

Milling Machine Replacement Spindle for "Flash-Change" Tooling

Easily installed replacement spindle that adapts any Bridgeport milling machine for Microbore "Flash-Change" tooling announced by Microbore Division, DeVlieg Machine Co., Royal Oak, Mich. This "Flash-Change" tooling system is designed to reduce down time on milling, drilling, and boring operations. The Flash-Change socket is an integral part of the spindle and has the strength and rigidity needed for roughing operations, as well as the accuracy required for precise finishing operations. In addition to the new spindle, a full range of standard Flash-Change adapters for end-mills, shell end-mills, drills, drill chucks, and single- or two-tool boring-bars is also available.

Circle Item 164 on postcard, page 201



"Multi-Tap" for Blind Holes

"Multi-Tap" developed by Winter Brothers Co., Rochester, Mich., for tapping blind holes in various kinds of materials, such as soft aluminum, stainless steels, magnesium, and some types of copper. A special treatment increases the surface hardness, retarding the abrasion encountered in these materials and promoting longer tool life. The taps are stock items in machine screw sizes No. 6 through No. 12, and from 1/4 inch through 3/4 inch in fractional sizes.

Circle Item 165 on postcard, page 201

Small-Size Speed Reducers

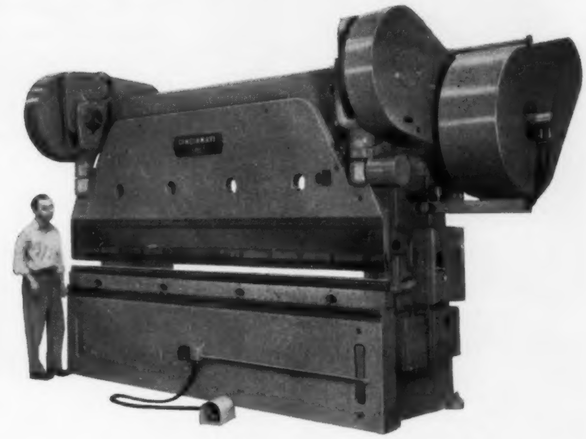
Three small-size speed reducers for light-duty applications have been announced by the Boston Gear Works, Quincy, Mass. Of the two models shown, the lower one, Model R113, is a miter-gear Reductor with a 1 to 1 ratio and a horizontal right-angle drive. It weighs only 3.75 pounds. The rated output ranges from 0.03 to 0.333 hp. The two other Reductors are of the worm-gear assembly type. Model T109 is designed with the worm-gear over the worm, and Model U109, shown in the upper view, has the worm-gear under the worm. Ratios for both Reductors range from 5 to 1 up to 30 to 1, and output from 0.03 to 0.08 hp.

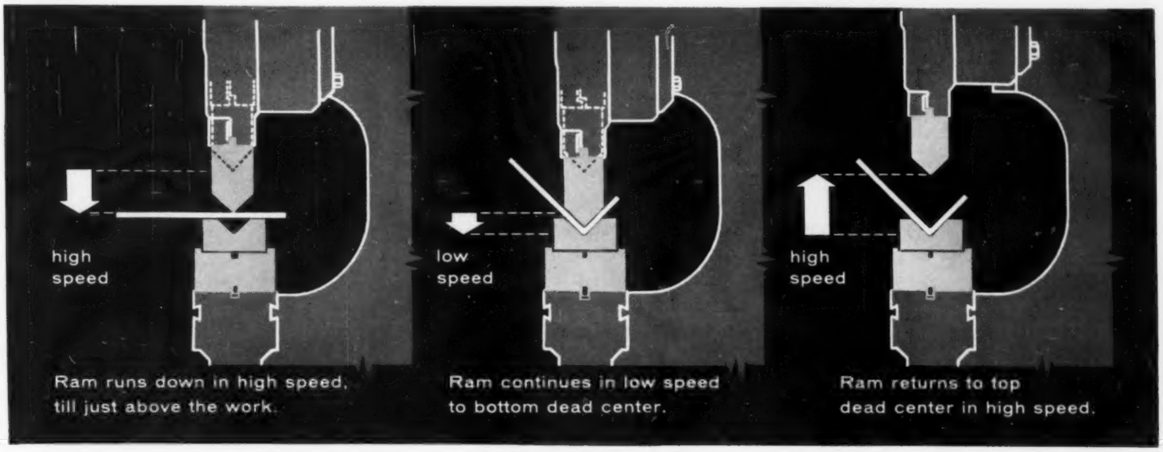
Circle Item 166 on postcard, page 201
(This section continued on page 222)

10 to 60% increase in production makes

CINCINNATI AUTOMATIC CYCLE

the most important press brake development in years!





Cincinnati Autocycle is a brand new feature which automatically provides two speeds to the ram for each stroke. It eliminates the "whip-up" of a sheet's free end that occurs when light gauge metal is formed over a small die opening at high speed.

Unlike previous attempts at reducing whip-up, the Autocycle does not slow down the entire stroke of the press brake's ram. Nor does it require clutch slipping, which depends entirely on operator skill and at best is unreliable.

Think what these advantages can mean for you:

1. Actual job records show 10% to 60% increase in parts produced per hour.
2. You can set the length of the low-speed working portion of the ram stroke. Once this is set, all strokes are identical, which insures absolute consistency in the work.
3. Work spoilage (such as back bends caused by whip-up) is eliminated.
4. Highly experienced operators are not required.
5. Operator fatigue is greatly reduced by eliminating clutch slipping.
6. Clutch and brake are long-life, minimum-maintenance units requiring no adjustments.

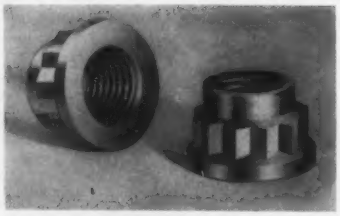
This productive new feature is available now on all 7 and 9 Series Cincinnati Press Brakes.

Get the full details about Cincinnati Autocycle in Bulletin B-9R. Address your request to Department D.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.



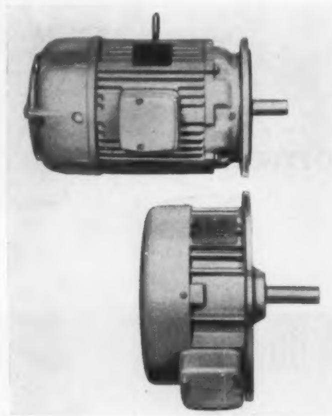
Self-Locking Nut for Aircraft

Lightweight, high-strength, 12-point external wrenching lock-nut for critical airframe fastening applications introduced by Standard Pressed Steel Co., Jenkintown, Pa. These Flexlox self-locking nuts, designated 42 FLW, are said to be as much as 25 per cent lighter than, though just as strong as, the standard 12-point aircraft nuts that they replace. The one-piece, all-metal lock-nuts—rated at 180,000 pounds per square inch minimum tensile strength—come in diameter sizes from 1/4 through 1/2 inch, National Fine series. Made of alloy steel, either plain or cadmium-plated, with molydisulphide coating optional. They are rated for temperatures up to 550 degrees F.

Circle Item 167 on postcard, page 201

Louis Allis Pancake Motor

Pancake motor (lower view) that reduces motor length up to 60 per cent over standard motors of the same rating made by the Louis Allis Co., Milwaukee, Wis. This motor is designed for use on machine tools, roof-ventilating fans, and many other space-cramped applications. For comparison, the lower view shows a 5-hp pancake motor and the upper view, a standard motor of the same horsepower. For normal operating conditions, it is built in an open drip-proof enclosure. Where dirt, filings, corrosive chemicals, coolants, or other contaminants are present, it is furnished in an enclosed con-

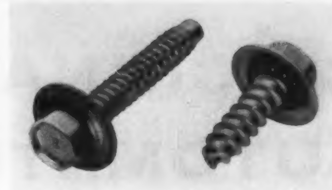


struction. The pancake motor is available in ratings from 1 to 15 hp at 1800, 1200, and 900 rpm. Additional features include vertical or horizontal mounting, cast-iron housing-bearing bracket, factory lubricated bearings, and quiet operation.

Circle Item 168 on postcard, page 201

Sealing Fastener Conforms to Curved Surface

Sealing type fastener designed to provide a secure triple seal on irregular, corrugated, or curved surfaces, as well as flat surfaces, introduced by Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Trademarked "Spin-



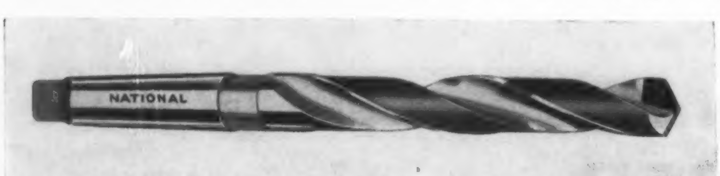
Seal," this fastener consists of a patented spring type, hardened washer with a permanent, flowed-in gasket sealant which is pre-assembled to any type of standard machine screw, cap-screw, or bolt. The patented "Bartite" washer is a product of L. J. Barwood Mfg. Co., Inc. It will withstand service temperatures from minus 100 to plus 250 degrees F. On a flat surface with a hole clearance of 1/16 inch, the fastener withstood a pressure of 2000 psi. Supplied in screw sizes from No. 6 to 1/2 inch.

Circle Item 169 on postcard, page 201

Carbide-Tipped and Solid-Carbide Twist Drills

One of a complete line of carbide-tipped and solid-carbide twist drills designed by National Twist Drill & Tool Co., Rochester, Mich., for drilling various types of non-metallic and non-ferrous materials. These are now available from stock in all popular styles and sizes.

Circle Item 170 on postcard, page 201



Gits Air Filter

Air filter, produced by Gits Brothers Mfg. Co., Chicago, Ill., to remove harmful moisture, rust, pipe scale, and other contaminants from air lines. Use of the filter prevents damage to pneumatic equipment and eliminates excessive wear. A large petcock permits fast, complete removal of harmful materials. Simple construction facilitates disassembly for cleaning. Designed specifically for use in connection with Gits matched-set air-line lubrication system, but may be used in other systems.

Circle Item 171 on postcard, page 201

(This section continued on page 224)

CLEVELANDS

automatically set the pace for progress!

Whitin Machine Works, Whitinsville, Mass., builders of textile preparatory machinery and other products, in part of a $4\frac{1}{2}$ million expansion program, has created one of the outstanding screw machine departments in the East. *Sixteen new Cleveland Single Spindle Automatics* (14, Model AB 3″ Dialmatics and 2, Cleveland $4\frac{1}{4}$″ Model AW's) are among the facilities that are automatically setting the pace for progress at Whitin Machine Works.

William Steele, Divisional Superintendent, and Eino Johnson, Department Foreman, describe this ultra-modern installation as "one that few companies anywhere can equal. Our machine tool investment includes highly versatile Cleveland Automatics, many with electronic controls, that make possible higher production with still closer tolerances . . in many instances to 0.0005″. As has been wisely said, 'you cannot build today's products with yesterday's machines, and still be in business tomorrow'."

Let Clevelands automatically set the pace for progress in your plant. Call in a Cleveland Automatic sales engineer.

THE CLEVELAND AUTOMATIC MACHINE COMPANY

4936 Beech Street
Cincinnati 12, Ohio

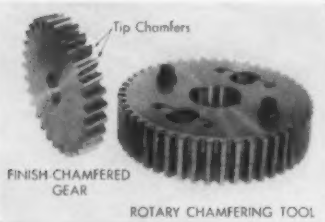
SALES OFFICES: CHICAGO
CLEVELAND • DETROIT
HARTFORD • S. ORANGE

Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

For more info on any products advertised this issue use card, page 201

Red Ring Rotary Gear-Tooth Chamfering Tool

Specially designed rotary gear-tooth chamfering tool for Red Ring process developed by National Broach & Machine Co., De-

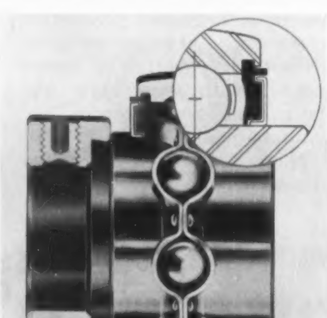


troit, Mich. The chamfering tool is mounted on the cutter spindle of a conventional rotary gear-shaving machine in mesh with the gear to be chamfered. The chamfering operation is performed by reciprocating and rotating the tool while feeding it to tight-mesh depth. The tool assembly is available in a variety of sizes having curved or angular-shaped tooth forms made to generate a specific profile-blended or straight chamfer on the tips of the teeth. The high-speed steel, rotary chamfering tool is assembled within a split guide gear. Although initially designed for marine type gears, the process can be applied to any type of spur or helical gear teeth.

Circle Item 172 on postcard, page 201

Ball Bearing for Power-Transmission Machinery

New series M-R-C power-transmission ball bearing for conditions involving extremes of dirt and



moisture announced by the Marlin-Rockwell Corporation, Jamestown, N. Y. This bearing accommodates commercially ground inch shafting and may be used in standard pillow blocks. It is prelubricated and equipped with M-R-C "Labri-Seals" that consist of a metal flinger pressed on the ground outside diameter of the inner ring and forming a close running labyrinth seal with the outboard face of a synthetic rubber element which is snapped into a groove in the bore of the outer ring. The metal flinger repels dirt and moisture and protects the thin, flexible lip of the synthetic rubber portion which runs on the outside diameter of the inner ring, providing a positive-contact seal.

Circle Item 173 on postcard, page 201

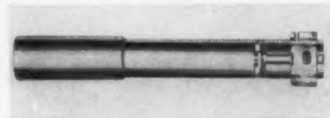
Aro Portable Tools with Noiseless Exhaust

One of a series of portable tools with noiseless, blastless exhaust introduced by the Aro Equipment Corporation, Bryan, Ohio. Initial models now available are light- and medium-duty types of drills, screwdrivers, and tappers. The exhaust air is routed back through a system roughly parallel to the inlet system, and escapes at a point adjacent to the air inlet. A porous bronze diffuser, located at the outlet, deadens any remaining exhaust noise and dissipates the escaping air evenly in all directions.

Circle Item 174 on postcard, page 201

Clark Finishing and Roughing Bar

Finishing and roughing bar designed to minimize setups and expedite adjustment and blade exchanges without removing bar from machine, brought out by the

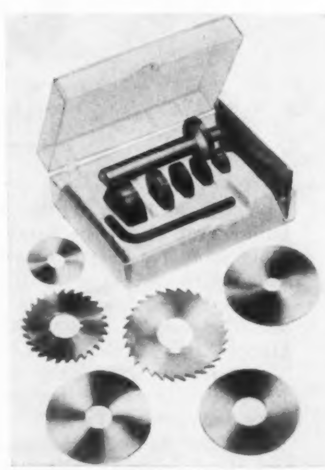


Robert H. Clark Co., Beverly Hills, Calif. A floating mount is said to balance the chip load between the two cutting edges, producing a far smoother surface on precision-finishing work. Blades can be adjusted to cover a wide range of bore sizes and to allow for numerous regrinds. Several blade sizes are available for each bar. Cutting blades are furnished in M-3 type high-speed steel or carbide-tipped.

Circle Item 175 on postcard, page 201

Tom-Tec Saw and Cutter Holder

Tom-Tec 400-In-One circular saw and cutter holder announced by Tom-Tec Products, Burbank, Calif. This equipment is designed to save tooling costs and setup time. The holder can be used on any spindle-equipped power machine such as a lathe, drill press, etc. It is precision-made, hardened, and given a black-oxide finish. The outstanding feature of this Curtis



holder is the facility with which it can be set up to hold any one of more than 400 different types and sizes of circular saws or cutters. The holder will take up to a 4-inch diameter cutter of any thickness up to 3/16 inch.

Circle Item 176 on postcard, page 201

DYNAMATIC

Drive Package Provides Infinitely Adjustable Speeds from AC Power Source

CONTROL
PANEL

CONTROL
STATION

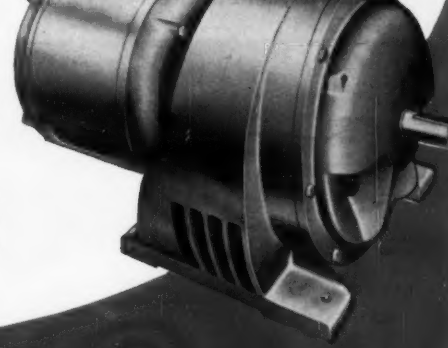
The complete Dynamatic power package includes all components required to provide infinitely adjustable speeds from an alternating current power source. A Dynamatic Ajusto-Spede® or Dynaspede® Drive, with electronic control and pushbutton station, satisfies the requirements of almost any application where proper machine operation or material processing depends upon control of operating speeds.

The compact control panel may be remotely mounted to conserve valuable space on the driven machine. The pushbutton station at the operator's position puts vital controls conveniently at the operator's fingertips and requires a minimum of space.

Speeds are infinitely adjustable from 0 RPM to full output speed, and accurate speed regulation may be obtained from 100 RPM to full output speed.

Ajusto-Spede® Drives, available in ratings of 1/4 horsepower to 75 horsepower, are air-cooled. Dynaspede® Drives, rated from 3 to 75 horsepower, are liquid-cooled. Raise your productive efficiency with Dynamatic eddy-current units.

DYNAMATIC®
AJUSTO-SPEDE DRIVE



Send for Illustrated Literature Describing Dynamatic Adjustable Speed Drives

EATON

DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

By E. S. Salichs

BETWEEN GRINDS

Noise is News?

Rocket roar is being made at the Sandia Corporation, the purpose being to help engineers design electromechanical components which can withstand the high-intensity sound of jet and rocket engines (*Industrial Research Newsletter* tells us). Four loudspeaker type drives, attached to four "pipe-organ" pipes, generate noise ranging up to 153 decibels, the sound intensity at the throat of a J-57 engine or rocket motor—the equivalent, in other words, of a rock-n-roll party at its height.

Coffee in Your Saucer?

Saucer-like containers have been developed to drop fuel, water, and other liquids to stranded troops, explorers, and hunters. These flying, or falling, saucers are made of rubber and hold 5 gallons of liquid. They have been dropped 2000 feet without bursting. Try for 2100 feet?

Crash on the Line

As part of a crash-research program, General Motors Proving Grounds engineers have developed a remote control so a driver can guide an automobile toward a smashup several hundred feet away. The "driver" sits at the control console which, in effect, is a duplicate of the controls of the car he is dispatching to a crash. Wonder if *this* would satisfy the little woman?

Blue Skies, or No Blue Prints

A letter dated December 10, 1902, was recently discovered in old files of the Chambersburg Engineering Co., addressed to a customer, the Vulcan Steel Co., on the subject of hammer foundations. The letter stated, "We will mail the blueprints to you tomorrow, as we cannot get a print today on account of the darkness and rain." How many old-timers will recall when the blueprint frames were a common sight outside the drafting-room windows on a sunny day?

Melting Pot

To show the world-wide nature of purchasing operations at the Bethlehem Steel Corporation, the raw materials used in a specific heat of steel at a Bethlehem plant were listed in *Bethlehem Review* as follows: Manganese from Brazil; iron wolframite from Korea; chromium ore from the Philippines; and magnesite from Austria.
ore from Chile; fluorspar from Spain;

Better Bags

Tearproof grocery sacks now can be made, using a new stretchable paper, we read in *Industrial Research Newsletter*. A picture of housewives crying into bags of high-priced food came to mind until it occurred to us that we were off the beam in our pronunciation of "tearproof." Shred, no—shed, a tear for us.

HIS POCKET HEARS YOU CALLING—An electronic personal calling system has been developed by AC Spark Plug Division of General Motors, especially useful for people on the move in large industrial plants. Here we see Howard W. Vauter, general foreman of maintenance and construction at the Flint, Mich., plants of AC, placing "Vibacall" in his shirt pocket. When this device, a radio receiver about the size of a pack of cigarettes, starts vibrating, Mr. V. is alerted, telephones a message center set up for the purpose, and receives his message—all done in a few seconds without loudspeakers, flashing lights, or bells.

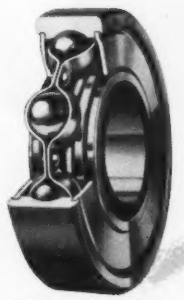
NORMA-HOFFMANN

precision NH *bearings*

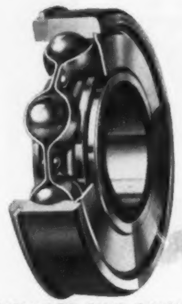
FOR EVERY LOAD, SPEED AND DUTY OVER 100 DISTINCT SERIES

SIZE RANGE 1/8" TO 21" BORE--METRIC AND INCH

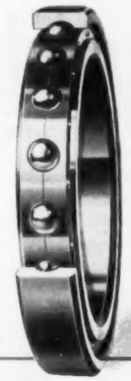
Write for catalog and engineering assistance



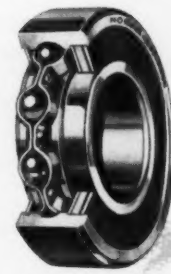
DOUBLE SHIELDED BALL BEARING



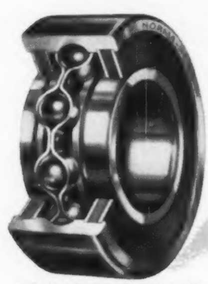
SHOULDER RING SINGLE SHIELDED BALL BEARING



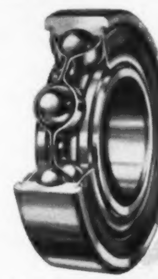
EXTRA LIGHT BALL BEARING



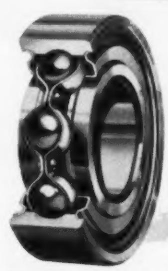
FELT SEALED AND SHIELDED BALL BEARING



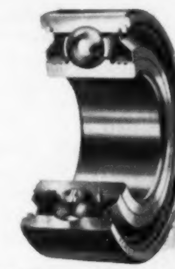
DOUBLE FELT SEALED BALL BEARING



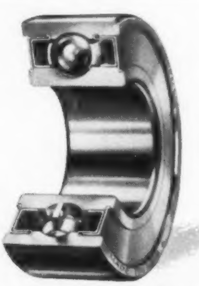
DOUBLE RUBBER SEALED BALL BEARING



DOUBLE METAL SEALED BALL BEARING

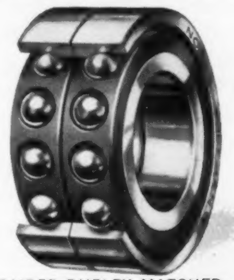


"CARTRIDGE" BALL BEARING WITH REMOVABLE SEALS



"CARTRIDGE" BALL BEARING WITH FLINGER SEALS

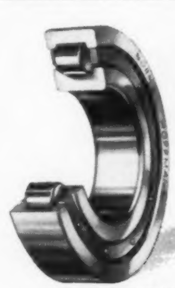
AIRCRAFT CONTROL FULL TYPE RUBBER SEALED BALL BEARING



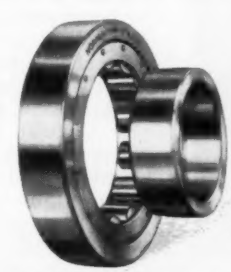
PAIRED DUPLEX MATCHED SUPER-PRECISION BALL BEARINGS

BALL THRUST BEARING

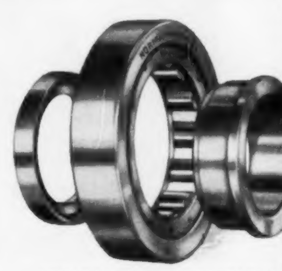
SEPARABLE OUTER RING ROLLER BEARING



SELF-CONTAINED ROLLER BEARING



SEPARABLE INNER RING ROLLER BEARING



SEPARABLE ROLLER BEARING WITH EXTRA THRUST RING

NORMA-HOFFMANN BEARINGS CORPORATION / STAMFORD, CONNECTICUT

founded in 1911

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News OF THE INDUSTRY

California

Budd Co., Philadelphia, Pa., has announced the appointment of William L. Disston as sales manager, Defense Division, western region. He will make his headquarters in Budd's new office in Los Angeles, Calif., at 3141 Century Blvd., Inglewood. In addition to the Defense Division, the new western office will coordinate activities of the company's Nuclear Systems Division and two Budd subsidiaries, Tatnall Measuring Systems Co. and Continental-Diamond Fibre Corporation.

Illinois Tool Works, Chicago, Ill., has established a West Coast division which will be known as the Calinoy Division. Office and plant facilities of the new division are located at 12917 Cerise Ave., Hawthorne, Calif. Herbert O. Hansen, formerly Shakeproof district sales manager, has been promoted to the position of division sales manager. Thomas R. Boyd will be in charge of engineering and manufacturing. Illinois Tool Works also announces the purchase of the controlling interest in Pacific Solenoids, Inc., El Segundo, Calif.

Illinois, Indiana, and Iowa

Joseph T. Ryerson & Son, Inc., Chicago, Ill., announces the appointment of Paul J. Fountain as manager of stainless steel sales. He replaces Philip B. Van Horne who becomes consultant, stainless sales. A member of the Ryerson organization for twenty-five years, Mr. Fountain first entered stainless steel sales work in 1937.

Paul J. Fountain, newly appointed manager, stainless steel sales, Joseph T. Ryerson & Son, Inc.

Burton J. Naden has been appointed to the position of general sales manager of Vascoloy-Ramet Corporation, Waukegan, Ill. Mr. Naden, with twenty-four years of service with V-R, has been active in the sale of V-R products for the past eighteen years throughout the industry.

Burton J. Naden, general sales manager, Vascoloy-Ramet Corporation

Engis Equipment Co., Chicago, Ill., has announced the promotion of Robert E. Reid to general manager of its Hyprez Division. Walter B. Panko will be national sales manager of the Hyprez Division. Mr. Panko, who has been serving as assistant sales manager of the Hyprez Division, succeeds Joseph M. Throckmorton who is retiring from active duty. Mr. Throckmorton will continue to be available to the company as a consultant.

National Fluid Power Association, Evanston, Ill., elected new officers at its annual meeting on June 1. John A. Marsh has been named president. Other officers are: first vice-president L. L. Charlson, president of the Char-Lynn Co., Minneapolis, Minn.; and second vice-president Frank Flick, president of Flick-Reedy Corporation, Melrose Park, Ill. Mr. Marsh was formerly vice-president of the Association and had served as director since it was founded.

John A. Marsh, president, National Fluid Power Association

Paul P. Polonec has been named plant superintendent at the Rock Falls, Ill., plant of Russell, Burdsall

(This section continued on page 234)

Paul P. Polonec, plant superintendent, Rock Falls, Ill., plant, Russell, Burdsall & Ward Bolt and Nut Co.

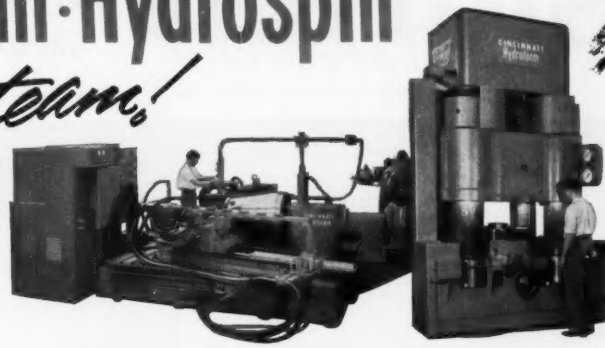


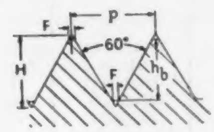
Fig. 3

Fig. 2

Fig. 1

Basic Thread Dimensions and Tap Drill Information

Fractional Sizes — American National Form



Formula

p = Pitch = $\dfrac{1}{\text{No. thds. per inch}}$

h_b = Depth = $p \times .64952$

F = Flat = $\dfrac{p}{8}$

H = Thd. 'V' Depth = $p \times .86603$

1	2	3	4	5	6	7
					Tap Drill	
Nominal Size	Basic* Major Diameter Inches	Basic* Pitch Diameter Inches	Basic Minor Diameter Inches	Maximum* Minor Diameter Class 1B, 2B & 3B Internal Thd.	Size Drill to Produce Approx. 75% Basic Thd. Engagement	Decimal† Equivalent of Drill
1/16-64	.0625	.0524	.0422	0518	3/64	.0469
3/32-48	.0938	.0803	.0667	.0793	49	.0730
1/8-40	.1250	.1088	.0925	1062	38	.1015
5/32-32	.1563	.1360	.1157	1312	1/8	.1250
36	.1563	.1382	1202	1338	30	1285
3/16-24	.1875	.1604	1334	.1530	26	.1470
32	.1875	.1672	1469	1616	22	.1570
7/32-24	.2188	.1917	.1646	.1834	16	.1770
32	.2188	.1985	.1782	.1922	12	.1890
1/4-20	.2500	.2175	.1850	.2067	7	.2010
24	.2500	.2229	.1959	2139	4	.2090
28	.2500	.2268	.2036	.2190	3	.2130
32	.2500	.2297	.2094	.2229	7/32	.2188
5/16-18	.3125	.2764	.2403	2630	F	.2570
20	.3125	.2800	.2476	2680	17/64	.2656
24	.3125	.2854	.2584	2754	I	.2720
32	.3125	.2922	.2719	2847	9/32	.2812
3/8-16	.3750	.3344	.2938	3182	5/16	.3125
20	.3750	3425	.3100	3297	21/64	.3281
24	.3750	.3479	.3209	.3372	Q	.3320
32	.3750	.3547	.3344	.3469	11/32	.3437
7/16-14	.4375	.3911	.3447	.3717	U	.3680
20	.4375	.4050	.3726	.3916	25/64	.3906
24	.4375	.4104	.3834	.3994	X	.3970
28	.4375	.4143	.3911	.4051	Y	.4040
1/2-12	.5000	.4459	3918	4223	27/64	.4219
13	.5000	.4500	.4001	4284	27/64	.4219
20	.5000	.4675	.4351	.4537	29/64	.4531
24	.5000	.4729	.4459	4619	29/64	.4531
28	.5000	.4768	4536	4676	15/32	.4687
9/16-12	.5625	.5084	.4542	4843	31/64	.4844
18	.5625	.5264	4903	5106	33/64	.5156
24	.5625	.5354	.5084	5244	33/64	.5156
5/8-11	.6250	.5660	5069	.5391	17/32	.5312
12	.6250	.5709	5168	.5463	35/64	.5469
18	.6250	.5889	.5528	5730	37/64	.5781
24	.6250	.5979	.5709	.5869	37/64	.5781

*Figures shown in columns 2, 3 and 5 are correct for Unified Thread Form as computed in American Standard Publication A.S.A. B1.1-1949.

†75% thread is rarely needed in small diameters. Use of a larger drill will reduce tap breakage.

(Continued on following page)

Extracted from "Standards and Dimensions for Taps and Dies" with permission of the publisher, Tap and Die Division, Metal Cutting Tool Institute, 405 Lexington Ave., New York 17, N. Y.

Basic Thread Dimensions and Tap Drill Information

Fractional Sizes — American National Form

(Continued)

1	2	3	4	5	6	7
					Tap Drill	
Nominal Size	Basic* Major Diameter Inches	Basic* Pitch Diameter Inches	Basic Minor Diameter Inches	Maximum* Minor Diameter Class 1B, 2B & 3B Internal Thd.	Size Drill to Produce Approx. 75% Basic Thd. Engagement	Decimal† Equivalent of Drill
11/16–11	.6875	.6285	.5694	.6022	19/32	.5937
12	.6875	.6334	.5793	.6085	39/64	.6094
16	.6875	.6469	.6063	.6284	5/8	.6250
24	.6875	.6604	.6334	.6494	41/64	.6406
3/4–10	.7500	.6850	.6201	.6545	21/32	.6562
12	.7500	.6959	.6418	.6707	43/64	.6719
16	.7500	.7094	.6688	.6908	11/16	.6875
20	.7500	.7175	.6850	.7037	45/64	.7031
13/16–10	.8125	.7476	.6826	.7170	23/32	7187
12	.8125	.7584	.7042	.7329	47/64	7344
16	.8125	.7719	.7313	.7533	3/4	7500
20	.8125	.7800	.7475	.7662	49/64	.7656
7/8– 9	.8750	.8028	.7307	.7681	49/64	.7656
12	.8750	.8209	.7668	.7952	51/64	.7969
14	.8750	.8286	.7822	.8068	13/16	.8125
16	.8750	.8344	.7938	.8158	13/16	.8125
18	.8750	.8389	.8028	.8230	53/64	.8281
20	.8750	.8425	.8100	.8287	53/64	.8281
15/16– 9	.9375	.8654	.7932	.8322	53/64	.8281
12	.9375	.8834	.8293	.8575	55/64	.8594
16	.9375	.8969	.8563	.8783	7/8	.8750
20	.9375	.9050	.8725	.8912	57/64	.8906
1 – 8	1.0000	.9188	.8376	.8797	7/8	.8750
12	1.0000	.9459	.8918	.9198	59/64	.9219
14	1.0000	.9536	.9072	.9315	15/16	.9375
16	1.0000	.9594	.9188	.9408	15/16	.9375
20	1.0000	.9675	.9350	.9537	61/64	.9531
1 1/16–12	1.0625	1.0084	.9543	.9823	63/64	.9844
16	1.0625	1.0219	.9813	1.0033	1	1.0000
18	1.0625	1.0264	.9903	1.0105	1	1.0000
1 1/8– 7	1.1250	1.0322	.9394	.9875	63/64	.9844
8	1.1250	1.0438	.9626	1.0047	1	1.0000
12	1.1250	1.0709	1.0168	1.0448	1 3/64	1.0469
16	1.1250	1.0844	1.0438	1.0658	1 1/16	1.0625
18	1.1250	1.0889	1.0528	1.0730	1 1/16	1.0625
1 3/16–12	1.1875	1.1334	1.0793	1.1073	1 7/64	1.1094
16	1.1875	1.1469	1.1063	1.1283	1 1/8	1.1250
18	1.1875	1.1514	1.1153	1.1355	1 1/8	1.1250
1 1/4– 7	1.2500	1.1572	1.0644	1.1125	1 7/64	1.1094
8	1.2500	1.1688	1.0876	1.1297	1 1/8	1.1250
12	1.2500	1.1959	1.1418	1.1698	1 11/64	1.1719
16	1.2500	1.2094	1.1688	1.1908	1 3/16	1.1875
18	1.2500	1.2139	1.1778	1.1980	1 3/16	1.1875
1 5/16–12	1.3125	1.2584	1.2043	1.2323	1 15/64	1.2344
16	1.3125	1.2719	1.2313	1.2533	1 1/4	1.2500
18	1.3125	1.2764	1.2403	1.2605	1 1/4	1.2500

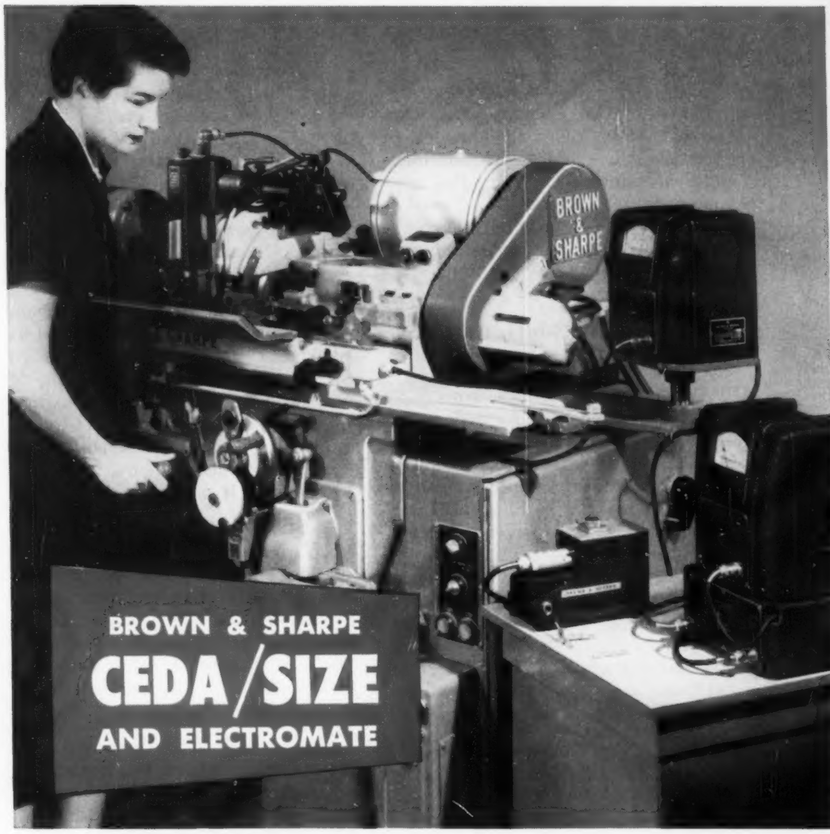
*Figures shown in columns 2, 3 and 5 are correct for Unified Thread Form as computed in American Standard Publication A.S.A. B1.1-1949.

†75% thread is rarely needed in small diameters. Use of a larger drill will reduce tap breakage.

(To be continued in October MACHINERY)

Extracted from "Standards and Dimensions for Taps and Dies" with permission of the publisher, Tap and Die Division, Metal Cutting Tool Institute, 405 Lexington Ave., New York 17, N. Y.

Grinding to $\pm$0.000010″ <u>or less</u>
in production – with average operators



...clearance of mating parts held to $\pm$0.000020″ <u>or less</u>

IS YOUR PRODUCTION of precision parts still paced by slow, high-cost methods such as lapping? If the specified size can be *measured,* it can now be *duplicated,* within millionths, *by plunge grinding* — with the new Brown & Sharpe CEDA SIZE Plain Grinding Machine.

CEDA SIZE was first developed to permit grinding to the extremely close limits required for sizing and fitting fuel injector and missiles parts — on a *production* basis, with operators of limited experience. Now, it is the practical answer to closer tolerance specifications for many products, such as gages, tools, instruments, and precision machine parts. With the Electromate attachment, combined with CEDA SIZE, clearances in mating parts can be held to 20 millionths or less.

Why not get figures on your potential savings with CEDA SIZE? For complete information, write: Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

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Brown & Sharpe BS

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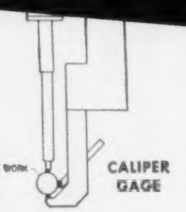
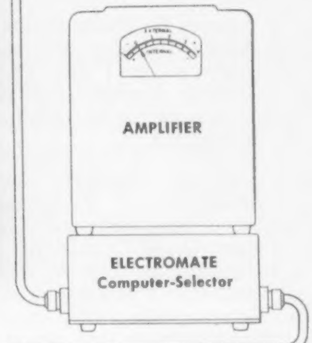
MACHINE TOOL ACCESSORIES • PRECISION TOOLS • HYDRAULICS • CUTTERS

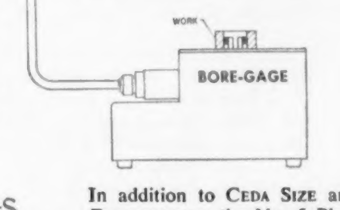
A new era in precision



With the CEDA SIZE equipped B&S No. 5 Plain Grinding Machine, diameter readings are transmitted to Amplifier from Electronic Caliper Gage riding on work. When diameter is within about fifty millionths of finished size, CEDA SIZE lever is depressed, which produces and controls an extremely fine grinding feed. When Amplifier indicator reaches zero, the specified size has been duplicated to $\pm$0.000010″ or less.



The ELECTROMATE Computer-Selector attachment, when used with CEDA SIZE, automatically computes the differential between the internal diameter of the mating sleeve (set on Electronic Bore Gage) and the external diameter of the part being ground. When indicator reaches zero, clearance (preset with masters) has been duplicated to $\pm$0.000020″ or less.



In addition to CEDA SIZE and ELECTROMATE the No. 5 Plain Grinding Machine shown is also fitted with ELECTRALIGN (upper rear amplifier) to insure easy, accurate control of taper.

& Ward Bolt and Nut Co., Port Chester, N. Y. Mr. Polonec has been associated with R B & W for more than fifteen years.

James L. Wheeler, appointed general manager, Die Division of Clearing Machine Corporation

JAMES L. WHEELER was recently appointed general manager of the newly enlarged Die Division of Clearing Machine Corporation, a division of U. S. Industries, Inc., Chicago, Ill.

WALDES KOHINOOR, INC., Long Island City, N. Y., has appointed LEWIS HAMMOND and GORDON S. METCALFE of Chicago, Ill., as representatives in northern Illinois and northwestern Indiana for its Truarc Retaining Rings Division. The new representatives will operate under the company name of Hammond & Metcalfe, with offices at 130 N. Wells St., Chicago, Ill.

A. FINKL & SONS CO., Chicago, Ill., have appointed A. F. FINKL vice-president in charge of national sales. He succeeds E. H. GRAHAM, who has been elevated to executive vice-president.

JOHN SPAULDING has been elected president of the Skil Corporation, Chicago, Ill., effective September 2.

GEORGE HARMON & ASSOCIATES, a manufacturers design service, has been formed in South Bend, Ind., it has been announced by George Harmon, president of the new organization. Offices of the firm are located in the Kirk Bldg., 220 S. Williams St., South Bend, Ind.

CUMMINS ENGINE CO., INC., Columbus, Ind., has announced plans for construction of a major addition to its manufacturing plant with construction to start late in 1958. The new facilities will include new engine test cells, additional space for the assembly of marine engines, diesel-electric generating sets, power units, and adequate export boxing areas and shipping docks.

MAYTAG CO., Newton, Iowa, announces the following changes in personnel: L. C. MCANLY, SR., manager of manufacturing for the company, retired August 29. PAUL A. STEWART, who has been general manager of production planning, will succeed Mr. McAnly.

Michigan, Missouri, and Virginia

WHEELABRATOR CORPORATION, Mishawaka, Ind., has formed a new division as the result of acquiring the former CRANDALL ENGINEERING & MFG., INC., Vicksburg, Mich., to be known as the Techline Division. This division will have its headquarters at Vicksburg, with complete experimental and demonstration laboratories. GEORGE H. LIESER will be field sales manager. ROY ROMINE, who founded Crandall Engineering in 1957, will be chief engineer, and LEE STEVENS will be director of process engineering.

DOW CHEMICAL CO., Midland, Mich., announces the appointment of HUBERT FRUEHAUF as manager of a new magnesium products department. As head of this unit, which replaces the Dow magnesium department, Mr. Fruehauf will be responsible for magnesium fabricating and semi-fabricating operations at the company's Bay City Division, Bay City, Mich., and the Madison Division, Madison, Ill. DR. J. D. HANAWALT, manager of the former magnesium department, will devote his major effort to research and magnesium development.

JOSEPH T. MILLER, JR., has been appointed manager of bearing sales for the Hoover Ball & Bearing Co., Ann Arbor, Mich. Mr. Miller is also directly in charge of supervising the company's field sales force.

J. TOM MAIDENS has been appointed sales supervisor for the End-Mill Division of Eclipse Counterbore Co., Detroit, Mich., with headquarters at the company's offices, 1600 Bonner Ave., in that city. Eclipse now has completely moved its end-mill manufacturing facilities from North Branch, N. J., to the Eclipse plant at Detroit.

ROBERT E. KING has been appointed distribution equipment sales manager for the Square D Co., Detroit, Mich. Mr. King joined the company as a student engineer in 1947 and served as a field engineer at Cincinnati from 1948 to 1953.

VEE BEE MFG. CO., Muskegon, Mich., has started production of boring-bars and cutters for metal-working applications, according to WILLARD F. BIEREMA, partner and sales manager of this new firm. It was formed January 1, 1956, to do contract work on precision aircraft parts. CLARENCE VANDERLINDE is partner and plant manager.

SAHLIN ENGINEERING CO., INC., Birmingham, Mich., has increased its plant area by 5000 square feet. To be used mainly for development of new products and special automation machinery such as the sheet-feeder Sahlin, the addition brings to 16,700 square feet the total area occupied by Sahlin at this location.

VICKERS INCORPORATED, Detroit, Mich., has announced the following appointments: LESTER W. BUECHLER, formerly chief engineer at the Electric Products Division, St. Louis, Mo., has been appointed the Division's new general sales manager. JOSEPH L. BEHR has succeeded Mr. Buechler as chief engineer.

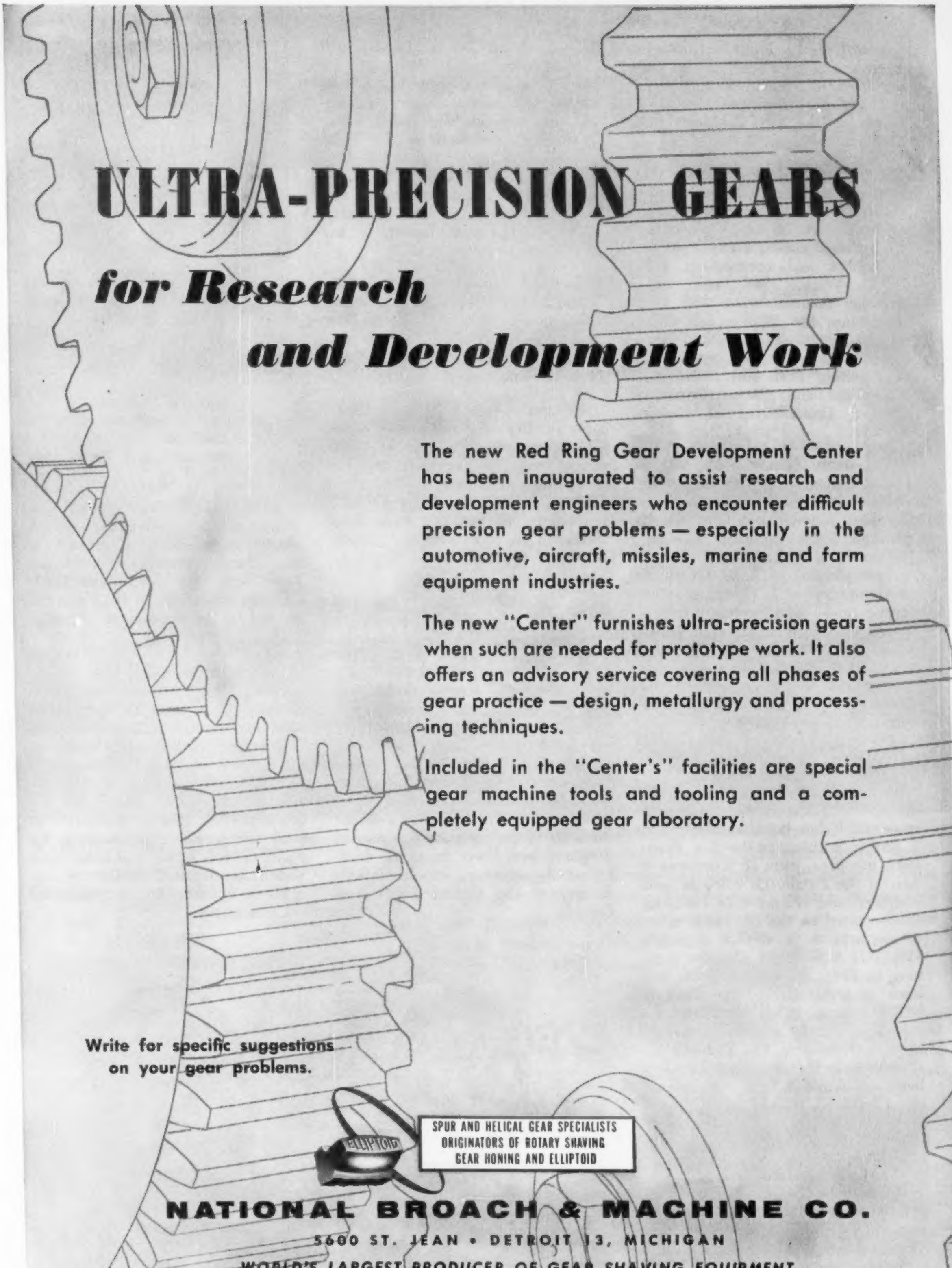
BIRDSBORO STEEL FOUNDRY & MACHINE CO., Birdsboro, Pa., has signed an agency contract with HOFFMAN-MARQUARD MACHINERY CO., 1525 N. Broadway, St. Louis, Mo. Hoffman-Marquard will handle all types of hydraulic presses and related equipment for Birdsboro in northern Illinois, eastern Missouri, and the state of Arkansas.

JOHN P. NEELY has been named manager of machinery and equipment market sales for Reynolds Metals Co., Richmond, Va.

New England

JOSEPH J. BARRETT has been promoted to superintendent of hot mills by Carpenter Steel of New England, Inc., Bridgeport, Conn. Mr. Barrett joined the Carpenter Steel Co. at its office and main plant in Reading, Pa., in 1950.

CAPEWELL MFG. CO., Hartford, Conn., announces that ROBERT O. BJORN has been appointed sales engineer in the Chicago area. Mr. Bjorn will have his headquarters in Capewell's new expanded office and warehouse at 3050 N. Cicero Ave.,


ULTRA-PRECISION GEARS
for Research
and Development Work
The new Red Ring Gear Development Center has been inaugurated to assist research and development engineers who encounter difficult precision gear problems — especially in the automotive, aircraft, missiles, marine and farm equipment industries.
The new "Center" furnishes ultra-precision gears when such are needed for prototype work. It also offers an advisory service covering all phases of gear practice — design, metallurgy and processing techniques.
Included in the "Center's" facilities are special gear machine tools and tooling and a completely equipped gear laboratory.
Write for specific suggestions on your gear problems.
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ORIGINATORS OF ROTARY SHAVING
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NATIONAL BROACH & MACHINE CO.
5600 ST. JEAN • DETROIT 13, MICHIGAN
WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT
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Chicago 41, Ill. FRED S. KOBOS has been made sales engineer in Wisconsin and Minnesota with headquarters in Milwaukee. JAMES D. QUIRK will be sales engineer in the St. Louis area.

GENERAL ELECTRIC Co.'s Distribution Assemblies Department of Plainville, Conn., announces two new appointments: A. A. WATSON has been named manager–marketing and assemblies and components sales. R. C. WILSON has been named manager–manufacturing and plant operations. Mr. Watson has served as manager–assemblies and components sales—a selling organization representing both the Distribution Assemblies and Circuit Protective Devices Departments of General Electric.

STANDARD SCREW Co., Wilson, Conn., has announced the promotion of H. T. THOMPSON to sales manager, standard fastener products, for its Chicago Screw Company Division, Bellwood, Ill. Other recent changes include election of E. L. CLAUSSEN as vice-president in charge of Stanscrew sales, and appointment of R. W. GRADY as standard fasteners sales manager, Hartford Machine Screw Division. W. J. COX continues to supervise Stanscrew sales activities for the firm's Western Automatic Machine Screw Co. Division.

NORTON Co., Worcester, Mass., has announced the following personnel changes: MYLES A. SNYDER, abrasive engineer in the Iowa area since 1951, has been transferred to a similar position in the San Francisco Bay area. JOHN H. SAUNDERS is now at the Pittsburgh office as field engineer, and WILLIAM D. POLLARD has reported to the St. Louis office to perform in a similar capacity. WILLIAM A. SIMONDS, abrasive engineer in Texas for several years, has been re-assigned to the western Massachusetts area. ROBERT C. DIVOLL, formerly of the Pittsburgh area, will succeed Mr. Simonds in Dallas, Tex. HAROLD F. PLATT has been appointed a field engineer at the Cleveland district office. JOHN H. HARTLEB has been appointed a field engineer at the Los Angeles district office.

HOWARD R. HOSKIN has been appointed sales manager of S. W. Card Division of Union Twist Drill Co., Mansfield, Mass.

BROWN & SHARPE MFG. Co., Providence, R. I., has announced the following personnel changes in the sales department of the Machine Tool Division: JAMES MEEHAN will assume new duties as assistant to the general sales manager. ALFRED R. SPARROW has been appointed director of grinding machine sales. WALTER W. APPLETON has been named director of screw machine sales. RONALD C. SMITH has been appointed sales representative for machine tools in Canada. DUNCAN J. BROWN has been named director of milling machine sales.

JONES & LAMSON MACHINE Co., Springfield, Vt., has appointed GEOFFROY-LANE, INC., 432 E. First Ave., Denver 3, Colo., as its distributor in Colorado, Wyoming, and New Mexico.

BRYANT GAGE & SPINDLE DIVISION of Bryant Chucking Grinder Co., Springfield, Vt., announces that the division has been reorganized and renamed BRYANT COMPUTER PRODUCTS DIVISION. Personnel and manufacturing facilities have been increased to cope with the greatly increased demand.

New York

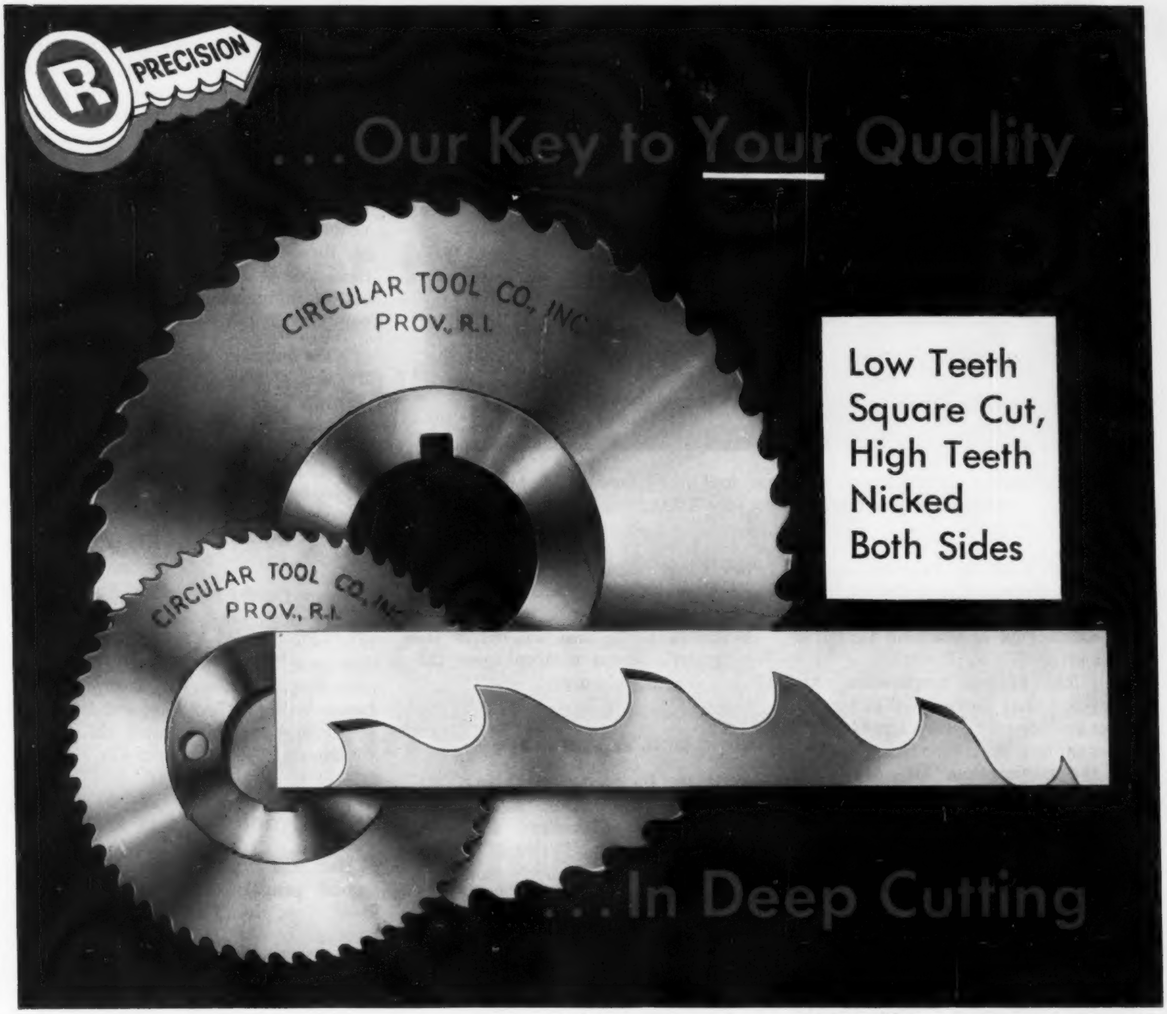
OAKITE PRODUCTS, INC., New York City, has appointed DR. CLARENCE BREMER, former director of research, as technical director. Dr. Bremer will be responsible for the company's research and product development, and technical service laboratories. WILLIAM A. BALTZELL has been appointed industrial sales manager. He will be responsible for the work of the company's seventeen divisions and two hundred forty technical service representatives throughout the United States and Canada.

J. C. Mabe, director and vice-president in charge of plant operations of the Chicago Pneumatic Tool Co.

J. C. MABE, vice-president in charge of plant operations, has been elected to the board of directors of the Chicago Pneumatic Tool Co., New York City. Mr. Mabe joined Chicago Pneumatic in 1955 and was elected a vice-president June 4, 1957.

STANDARD GAGE CO., INC., Poughkeepsie, N. Y., has announced that ROBERT C. GOULD is now direct sales and service representative for Connecticut, and EDWARD V. SEERO, for the rest of New England. Both replace manufacturers' agents. The company has also announced the acquisition of ROY F. LEONARD as sales and service representative for northern New Jersey and lower New York state. ROBERT C. GOULD, formerly in this territory, is transferred to Connecticut.

(Left) Dr. Clarence Bremer, technical director; (right) William A. Baltzell, industrial sales manager, Oakite Products, Inc.



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CHICAGO
Donald Robertson & Co.
CLEVELAND
Production Tool Co.
DAYTON
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DETROIT
A. D. Spruce
HACKENSACK
The Eaton Company
INDIANAPOLIS
Walter F. Greene & Associates
MILWAUKEE
Ford Tool Co.
NEW YORK CITY
J. B. Cremonin (Export)
PHILADELPHIA
General Tool Sales Co.
PHOENIX
DiEugenio Tool Center
PITTSBURGH
Ralph Esposito & Co.
PROVIDENCE
Fred J. McMillen
ROCHESTER
James O. Horne
ST. LOUIS
B. C. MacDonald & Co.
WESTBURY, L. I.
The Eaton Company
MONTREAL
Humphrey B. Walton

632-7

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COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

CIRCULAR TOOL CO., INC.

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Specialists in Circular Cutting Tools Since 1923

(Left) Edward G. Maylinger, president, and (right) Kenneth W. Meytrott, chairman of the board, Ettco Tool & Machine Co., Inc.

ETTCO TOOL & MACHINE CO. announces the election of KENNETH W. MEYTROTT as chairman of the board of Ettco Tool & Machine Co., Inc., Brooklyn, N. Y. Formerly a vice-president of the corporation, Mr. Meytrott has been a director for over twenty years. EDWARD G. MAYLINGER has been elected president of the corporation. Mr. Maylinger has been associated with Ettco for thirty-two years. Both Mr. Meytrott and Mr. Maylinger succeed to their new positions following the recent death of Melvin H. Emrick, chairman and president since 1947.

GENERAL ELECTRIC CO., Schenectady, N. Y., announces changes in its gas turbine and large steam turbine - generator departments. CHARLES W. ELSTON becomes manager–engineering for the gas turbine (GT) department. JACK E. DOWNS becomes manager–turbine engineering for the LST-G department. HAROLD D. KELSEY becomes consultant–special engineering problems for the GT department in order to concentrate on specific aspects in the development of combustion gas turbines.

W. V. WARNER has been appointed to the newly created position of general sales manager, Ford Instrument Co., Sperry Rand Corporation, Long Island City, N. Y. Mr. Warner was formerly manager of Air Force Contracts, and prior to this assignment functioned as head of the Ford Instrument Co.'s Mid-West Engineering Office in Dayton, Ohio.

ARTHUR W. SCHRIEWER has been named eastern regional stainless steel specialist for Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corporation, Waterbury, Conn. He will make his headquarters at the Chase New York warehouse in Maspeth, L. I., and will cover the company's seven eastern sales districts and warehouses.

Ohio and Wisconsin

DAVID B. SAYLE has been appointed northern Ohio sales representative for Cleveland Crane & Engineering Co., Wickliffe, Ohio. Mr. Sayle was formerly southern district sales manager for Steelweld machinery and has been with the company for thirteen years. His office will be at 3537 Lee Road, Cleveland, Ohio.

RIVETT LATHE & GRINDER, INC., Boston, Mass., has appointed STANLEY M. PROCTOR CO., 1900 Euclid Ave., Cleveland 15, Ohio, as exclusive distributor in northern Ohio for Rivett air and hydraulic valves and cylinders.

NATIONAL TOOL CO., Cleveland, Ohio, has acquired the assets and assumed the liabilities of AUTO-VAC CO., Bridgeport, Conn. E. BOWMAN STRATTON, JR., president of Auto-Vac Co., has become a vice-president of National Tool Co. in charge of the Auto-Vac Division.

ERIE TOOL & SUPPLY CO., Toledo, Ohio, recently completed the move to their new building at 304 N. Westwood Ave. The company serves the Toledo, Fostoria, Findlay, Sandusky, and Port Clinton, Ohio, areas, as well as Monroe and Tecumseh, Michigan territories.

DUANE R. BRANAKA has been appointed sales manager of Valvair Corporation, Akron, Ohio.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, announces new appointments as sales engineers. JAMES H. CHAMBERS has been transferred to the sales office in Atlanta, Ga., RICHARD A. CHRISTMAN to Cincinnati, Ohio, MELVIN H. HARE to Greenville, S. C., MERLE M. MORROW to St. Louis, Mo., and MILLARD H. PHELPS to San Francisco, Calif., from previous assignments in application engineering and marketing at company headquarters.

NEW BRITAIN MACHINE CO., New Britain, Conn., announces the appointment of RICHARD M. JOHNSON as president of Koehler Aircraft Products Co., its subsidiary in Dayton, Ohio. The announcement was made in conjunction with the retirement of R. T. FIRSBIE, chairman of New Britain's executive committee.

TWIN DISC CLUTCH CO., Racine, Wis., has announced the election of two new members to its board of directors. They are RALPH J. KRAUT, president and director, Giddings & Lewis Machine Tool Co., and BRUCE F. OLSON, president and director, Sundstrand Machine Tool Co.

Pennsylvania

THOMAS P. WAGNER has been named president of the Standard Steel Specialty Co., Beaver Falls, Pa., succeeding JAMES B. JAMISON, who has been named chairman of the board. Mr. Jamison has been with the company since its beginning and has been president since 1947.

E. N. SMITH has been appointed technical director of the Kennametal, Inc., Latrobe, Pa., chemical

E. N. Smith, technical director, Kennametal, Inc.

and metallurgical laboratory. This facility serves as a testing and quality control center for several plants in the Latrobe area, and in Bedford, Pa., Detroit, Mich., and Milan, Italy. Mr. Smith has been associated with Kennametal, Inc. since 1945 when he joined the research staff.

LATROBE STEEL CO., Latrobe, Pa., has announced the following personnel changes: P. E. FEDELES has been appointed sales engineer for the metalworking industry in western Michigan. S. L. WEAVER has been named district sales manager of its Chicago office, covering Illinois and key areas in Indiana and Michigan. ALBERT J. WOODS has been named Buffalo district manager covering New York State. His branch office and that of the company is located at 2545 Walden Ave., Buffalo, N. Y. ROBERT E. SANSONETTI, sales representative, will cover southern Connecticut with headquarters at Latrobe's branch office, 112 Prospect Ave., Hartford, Conn.

E. F. HOUGHTON & CO., Philadelphia, Pa., have announced expansion of their Steel Mill Division for service and sales to iron and steel producers. Two specialists have been obtained to head up specific phases, working directly under DAVID J. RICHARDS, vice-president, sales. They are LOUIS SCHLOSSBERG, manager of the newly formed Strip Mill Sales Division, and WILLIAM C. JOHNS, manager of the Bar, Tube, and Wire Division. Mr. Schlossberg and Mr. Johns will work out of the Philadelphia Main Office at 303 W. Lehigh Ave.

WILLIAM D. WALLACE has been appointed director of manufacturing of Crown Cork & Seal Co., Inc. He will have his headquarters at the company's main office at 9300 Ashton Road, Philadelphia, Pa.

NORMAN A. FLETCHER has been appointed manager of manufacturing for the Valve Division, Minneapolis-Honeywell Regulator Co., Fort Washington, Pa.

The WIEDEMANN MACHINE CO. has opened its new plant in King of Prussia, Pa.

Canada

LODGE & SHIPLEY CO., Cincinnati, Ohio, machine tool manufacturer, has announced the appointment of J. H. RYDER MACHINERY CO., LTD., as distributors throughout the Dominion of Canada for its entire line of heavy-duty precision lathes. The Ryder organization is one of Canada's largest machinery distributors and has offices in Hamilton, Windsor, Winnipeg, Vancouver, and Montreal.

Obituaries

Frederick H. Chapin

FREDERICK H. CHAPIN, chairman of the board of directors of the National Acme Co., Cleveland, Ohio, died August 5 at his home in Cleveland Heights, Ohio. He was eighty-three. Mr. Chapin joined National Acme in 1926 as president and was

Frederick H. Chapin

elected board chairman in 1933. He resigned the presidency of the company in October 1957. Under his direction, the company became the world's largest manufacturer of a complete line of automatic bar and chucking machines. He was active in civic and philanthropic affairs in his community.

Melvin H. Emrick

MELVIN H. EMRICK, president and board chairman of the Ettco Tool & Machine Co., Inc., Brooklyn, N. Y., died June 30 at the age of forty-seven. Considered an expert in machine tool design, Mr. Emrick was a member of the New York chapter of the American Society of Tool Engineers for over twenty-five years. He was widely known throughout the metalworking industry for his developments in the drilling and tapping field, holding many patents.

Coming Events

SEPTEMBER 23-26—Association of Iron and Steel Engineers' 1958 Iron and Steel Exposition and Convention will be held in Public Auditorium, Cleveland, Ohio. The Association's address is 1010 Empire Building, Pittsburgh 22, Pa. The managing director: T. J. Ess; exposition manager: William C. Friesel.

SEPTEMBER 29-OCTOBER 3—American Society of Tool Engineers' Semi-Annual Meeting and Western Tool Show will be held at Shrine Exposition Hall, Los Angeles, Calif. Exposition committee: Leonard Abrams, ASTE, 10700 Puritan Ave., Detroit 38, Mich.; Harry E. Conrad, executive secretary.

OCTOBER 27-29 – Semi-annual meeting of AMERICAN GEAR MANUFACTURERS' ASSOCIATION at the Edgewater Beach Hotel, Chicago, Ill. For further information contact Association Headquarters, One Thomas Circle, Washington 5, D. C.

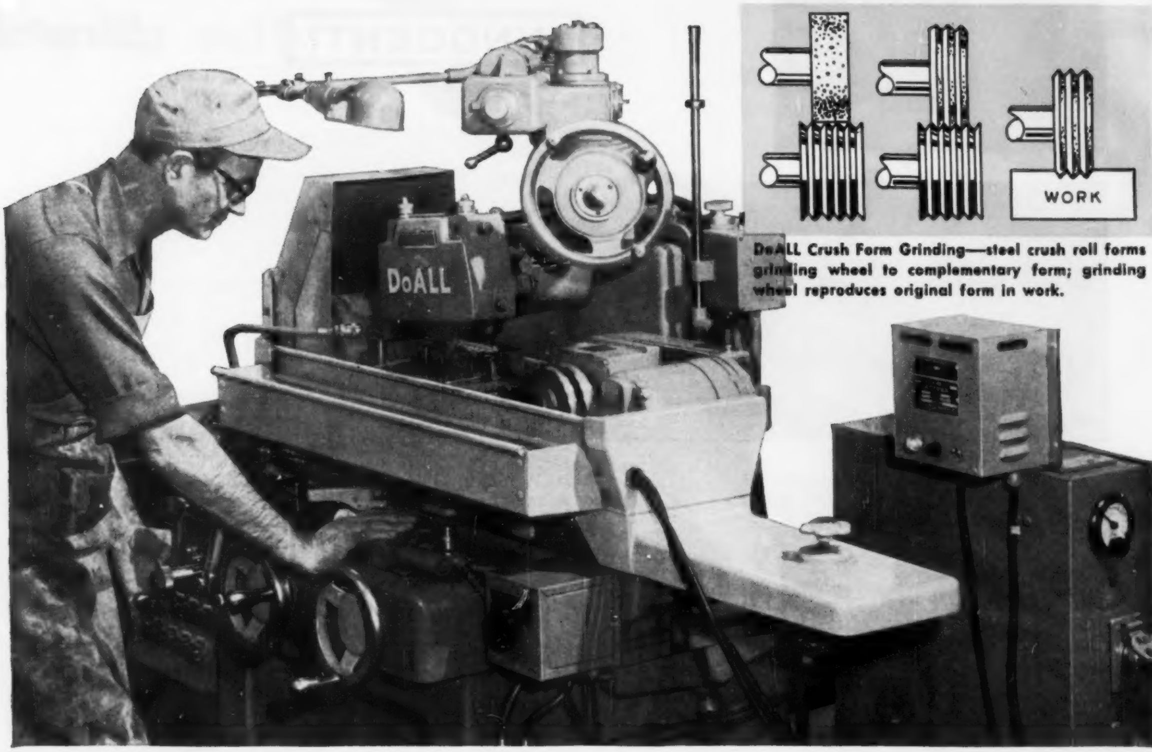
OCTOBER 27-31 – National Metal Exposition and Congress will be held at the Cleveland Public Auditorium, Cleveland, Ohio. The same week the annual meeting of the AMERICAN SOCIETY FOR METALS, the SOCIETY FOR NONDESTRUCTIVE TESTING, and the AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS—INSTITUTE OF METALS DIVISION, will be held. For further information contact American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. Adolph O. Schaefer, secretary.

DECEMBER 1-5—Twenty-Third Exposition of Power and Mechanical Engineering will be held at the Coliseum, New York City. For further information, contact International Exposition Co., 480 Lexington Ave., New York 17, N. Y. E. K. Stevens, manager.

° ° °

How to Sell to the Atomic Energy Commission

A revised edition of "Selling to (the) AEC" has been announced by the Atomic Energy Commission. This 34-page booklet describes the procurement program, the services and items purchased, and gives the names of agencies and individuals in charge. It is sold by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 25 cents.



DoALL Crush Form Grinding—steel crush roll forms grinding wheel to complementary form; grinding wheel reproduces original form in work.

MARCHANT CALCULATOR *finds an Answer*
with DoALL CRUSH FORM GRINDING

Marchant DECI• MAGIC calculator and workpiece (inset)—a division control gate hardened to .020" with surface reading of 52 to 56 Rockwell "C", then cadmium plated prior to grinding.

There may be a valuable idea for you in the way The Marchant Calculator Company, Oakland, Calif., solved a complex radius-grinding problem on the control gate fingers of their DECI • MAGIC—a modern calculator that performs division in record time.

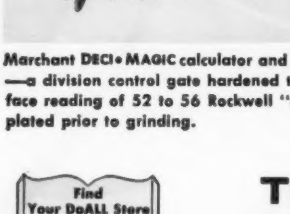
Previously, the radius was ground by rotating one finger at a time under a straight dressed grinding wheel. The wheel ran dry because the operator had to see the radius to determine how much stock to remove. The result of this hand operation was unavoidable variation on all 11 fingers. Still worse, an unwanted radius was generated .015" back of the finger tips—impossible to remove because of insufficient stock.

Installing a DoALL Crush Form Surface Grinder eliminated the problem entirely. The DoALL Grinder automatically controls the radius to within .0005", and holds total accumulative tolerance to .001". And with DoALL Cool Grinding (fed through the wheel) plus flood coolant, surface finish exceeds expectations and wheel life is greatly increased. Result: a precision production operation that enables Marchant to produce the DECI • MAGIC at lower cost and with fewer moving parts, made possible by the advanced features and rigid design of the DoALL Surface Grinder.

Need more proof of DoALL superiority in surface grinding? Call your local DoALL Store, or write the DoALL Company, Des Plaines, Illinois—ask for literature on the complete line of DoALL Surface Grinders.

The DoALL Company, Des Plaines, Illinois

GR-25

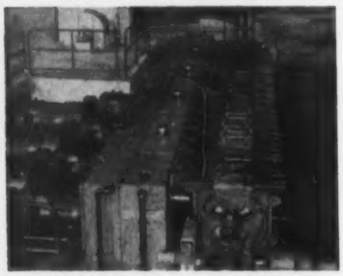


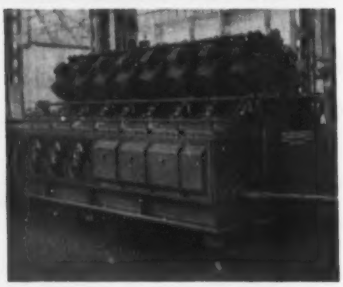
THIS IS A TYPICAL DoALL STORE

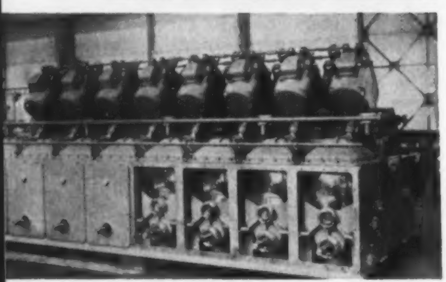
INNOCENTI

Stretch

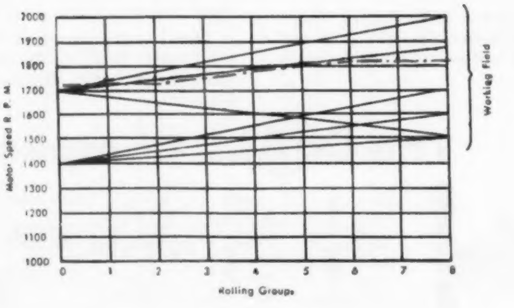
Works in Milan (Italy)







Stretch reducing Mills for seamless and welded tubes production; equipped with two Roll or three Roll stands. Direct current independent motor driving for two stand working unit. Electric speed regulation allows variation of the speed curve into a large field even with the mill in operation. Inlet section can be reduced of 6-7 times. Simultaneously thickness reduction can reach the minimum commercial value. Both types of mills are available equipped with number of stands ranging from 12 to 25 according to the producing programs Semi automatic device for quick replacement of stands. Special lathes for cylinder contour rectification. **Using stretch reducing mill it is possible to produce the whole commercial standard of tubes from 3/8". Feeding into the mill welded or seamless, large diameter or high thickness tubes, the production average of your plant can be doubled.**



reducing mills

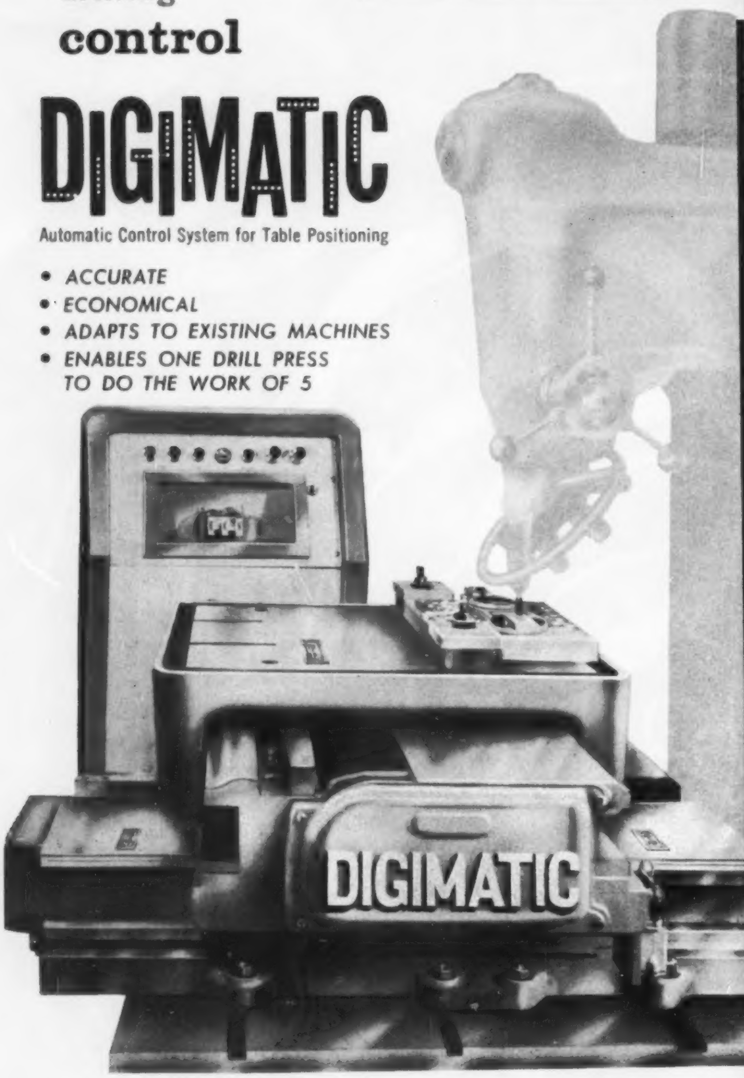
See DIGIMATIC
in action
at ASTE SHOW
Los Angeles
Booth No. 814

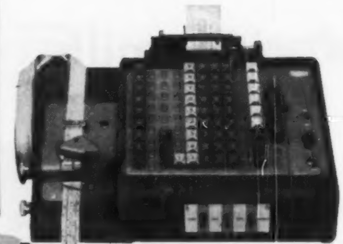
at last! truly practical **numerical** drilling **control**

DIGIMATIC

Automatic Control System for Table Positioning

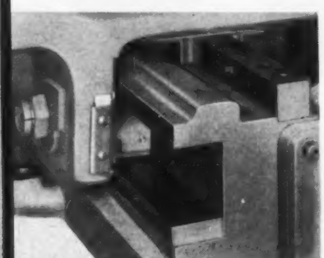
- ACCURATE
- ECONOMICAL
- ADAPTS TO EXISTING MACHINES
- ENABLES ONE DRILL PRESS TO DO THE WORK OF 5





Tape Preparation Unit. Easy-to-learn keyboard operation. No special codes . . . uses simple decimal coordinates. Provides printed accuracy check.

Control Unit. Compact data storage. One foot of 1-inch tape holds all instructions needed for fifteen 2-axis positions.



Rigidly Built Table. Heavy (1200 lbs.). Replaceable hardened steel ways and rollers.

All-Enclosed Mechanism. Completely sealed against coolant and chips to maintain ±0.0002 inch accuracy.

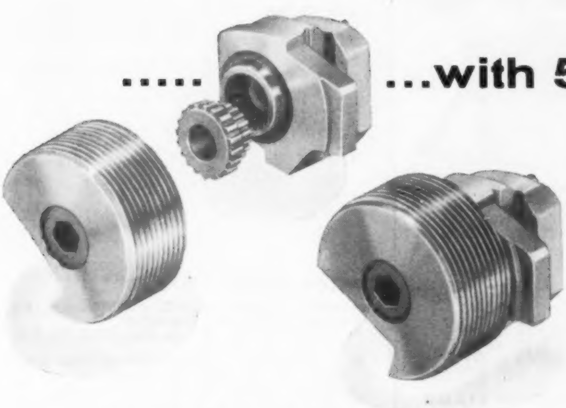
Write for illustrated brochure giving complete details and specifications.

Now available for immediate installation.
AUTOMATIC PATH CONTROL SYSTEMS ALSO AVAILABLE FOR YOUR PRESENT CONTOUR MILLING MACHINES

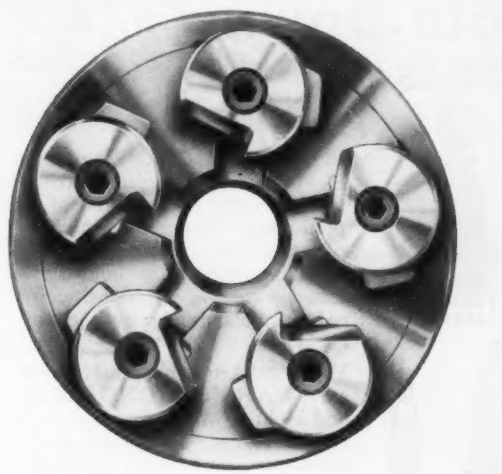
ECS

ELECTRONIC CONTROL SYSTEMS
DIVISION
STROMBERG-CARLSON COMPANY
A DIVISION OF GENERAL DYNAMICS CORPORATION
2231 South Barrington Avenue, Los Angeles 64, California

IMPROVE THREAD QUALITY AT COST SAVINGS YOU CAN MEASURE



....with 5 chaser Vers-O-Tools



Available from stock in sizes from $^{13}/_{16}$" to $3^{1}/_{2}$"

The superiority of Vers-O-Tool automatic die heads has been proven in thousands of applications. Basic design simplicity, unsurpassed economies in chaser grinding and precise relocation of chasers without re-adjustment . . . all have contributed to better threaded pieces at lower cost.

Now with 5 chaser heads available in a complete range of sizes . . . *add up these conclusive facts—and prove it to yourself!*

Write for complete information

- Elimination of out of round and drunken threads
- Chasers can be ground closer to center, resulting in smoother, more accurate threads
- 5 Chasers lighten the chip load on each tool
- Longer chaser life per grind—less machine down time
- 5 Chasers permit threading of parts with flats, slots, keyways, etc.

National Acme

THE NATIONAL ACME COMPANY
179 East 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

For more info on any products advertised this issue use card, page 201

Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

ABRASIVES, Disc
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Gardner Machine Co., Beloit, Wis.
Norton Co., 1 New Bond St., Worcester, Mass.

ABRASIVES, Polishing, Tumbling, Etc.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

Norton Co., 1 New Bond St., Worcester 6, Mass.

ACCUMULATORS, Hydraulic
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

AIR GAGES, Dimensional—See Gages Air Comparator

AIR GUNS
Chicago Pneumatic Tool Co., New York 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

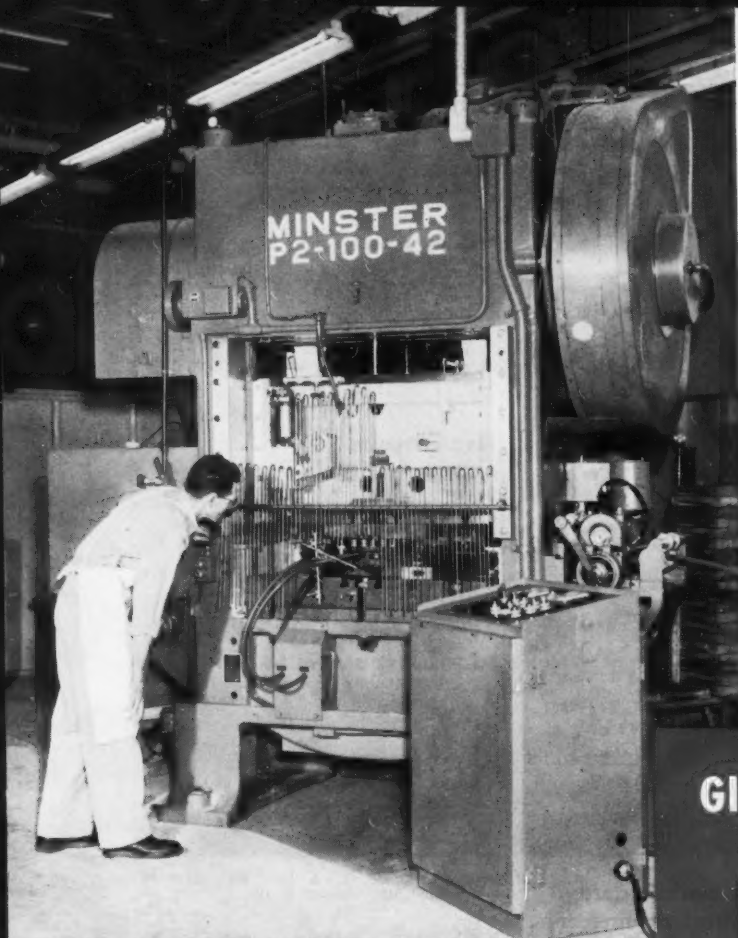
ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Mueller Brass Co., Port Huron, Mich.

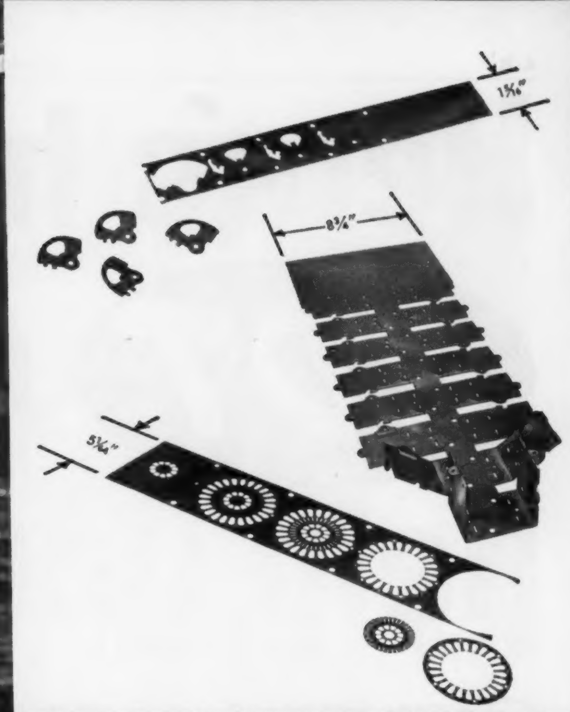
ALLOYS, Non-ferrous—See Brass, Copper, Zinc and Stellite

ALUMINUM and Aluminum Products
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-Up Equipment

ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.





GIVE YOUR COSTS A BREAK...

Run your progressive dies at their top speed in a Piece-Maker

A Minster Piece-Maker press will deliver the maximum productivity from your progressive dies. That means more profit for you.

A 100 Ton Piece-Maker (like the one shown above) will run efficiently at the highest speed at which any blank, notch, pierce, draw or cut-off progressive die can be run (150 to 300 spm are not uncommon) . . . and do it with real accuracy.

The precision-built Minster Piece-Maker automatic production press has the stability to run continuously, giving you the best possible die performance and longer life for expensive progressive dies.

With a Minster you get all the economies of automatic production and, equally important, you get the experience of Minster application engineers who help you match the press to the job.

Are you taking full advantage of automatic production? Let your Minster representative tell you more about the Piece-Makers.

Two Point (P2) Capacities from 20 to 300 Tons
Single Point (P1) Capacities, 75, 100 and 150 Tons

THE MINSTER MACHINE COMPANY

MINSTER, OHIO

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

ARC WELDERS—See Welding Equipment, Arc

ASSEMBLING MACHINES
Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single and Multiple-Spindle Automatic

AUTOMATION EQUIPMENT
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

BABBITT
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BALANCING EQUIPMENT
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

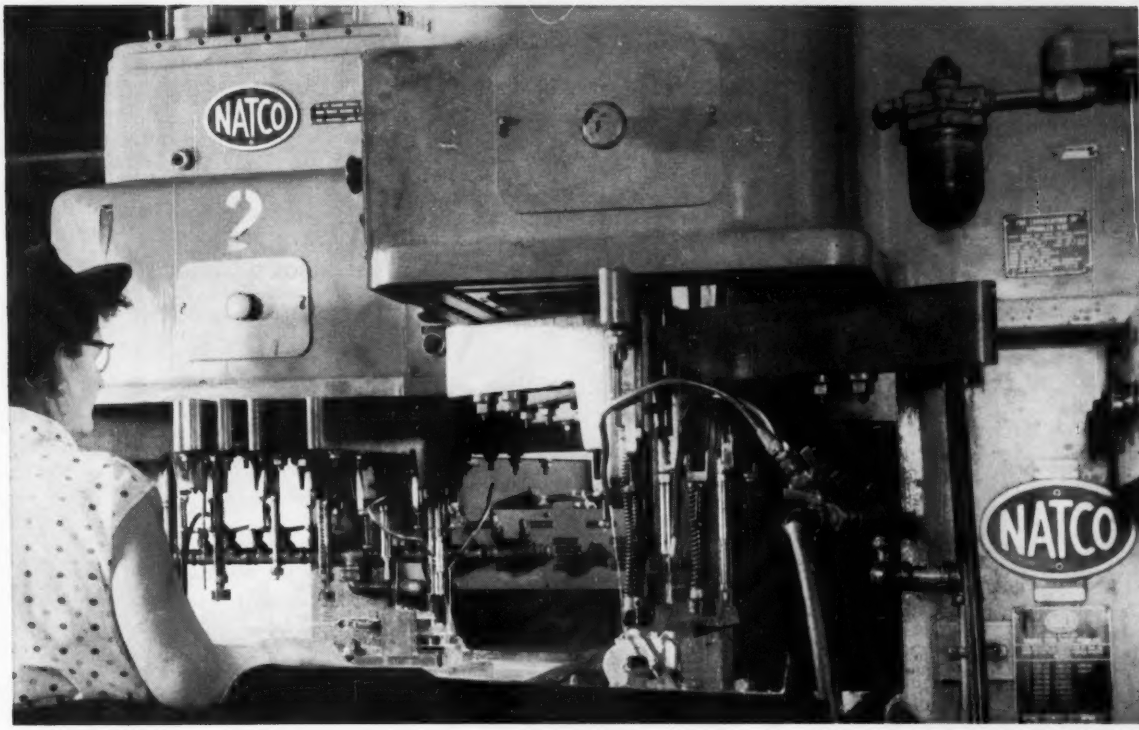
BALLS
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Hoover Ball & Bearing Co., Ann Arbor, Mich.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BAR STOCK AND SHAFTING, Steel
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES
Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Fafnir Bearing Co., New Britain, Conn.



Ten Natcos like these replaced 170 single spindles!

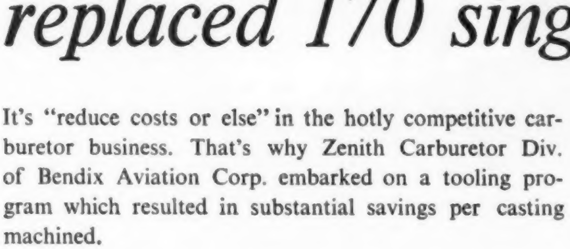
It's "reduce costs or else" in the hotly competitive carburetor business. That's why Zenith Carburetor Div. of Bendix Aviation Corp. embarked on a tooling program which resulted in substantial savings per casting machined.

Ten multiple spindle H-6 Natcos provided the greatest savings per machine dollar spent. By combining drilling and tapping operations, the Natcos eliminated the need for 170 single spindles. Look at the cost comparisons on two parts, for example—a die-cast cover and fuel bowl.

Formerly, the cover was machined by five operators using ten single spindles with ten jigs. The fuel bowl was formerly run by two operators on four single spindles using four individual jigs. Now these parts are run on two Natcos by a single operator at a direct cost savings of 81% on the cover and 70% on the fuel bowl.

Wherever hole-machining operations are performed one at a time, you'll find outstanding opportunities for cost reduction. Standard multi-spindle Natcos range from 1 hp, 10-spindle high-speed machines to giant heavy duties with 50 hp and up to 72 spindles. Natco also builds a complete line of special way-type, index and transfer machines.

A Natco field engineer can help you with your cost-reduction and production problems. Call or write today.



These are typical of the 140 different parts machined by Zenith on their Natcos in lots of 300 to 10,000

Somewhere in Natco's experience is a money-saving idea for YOU!

NATIONAL AUTOMATIC TOOL COMPANY, INC.

Richmond, Indiana

Natco offices in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland and Los Angeles; distributors in other cities.

BEARINGS, Ball

Ball & Roller Bearing Co., Danbury, Conn.
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffmann Bearings Corp., Stamford, Conn.

BEARINGS, Bronze and Special Alloy

Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

BEARINGS, Needle

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio

BEARINGS, Oilless

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARINGS, Roller

Ball & Roller Bearing Co., Danbury, Conn.
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

BEARINGS, Thrust

Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BENDERS, Bar, Tube, Channel, etc.

Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.


ANNOUNCEMENT
The Congo fields which produce crushing boart have increased their production considerably this year to meet the full demand of all world markets. The reserves are estimated at current rate of consumption to be sufficient to meet all requirements for at least the next half century.
This relief from the shortage of past years means that either fragmented boart or special graded mesh sizes will be available to American manufacturers of diamond grinding wheels, cutting discs and other tools.
YOU CAN DEPEND ON NATURAL DIAMONDS
INDUSTRIAL DISTRIBUTORS (SALES), LTD.

BENDERS, Plate, Etc.

Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDING MACHINES, Hydraulic

Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Sta., Buffalo, N. Y.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING MACHINES, Pipe

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING ROLLS

Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BLAST CLEANING EQUIPMENT

Pangborn Corp., Hagerstown, Md.

BLOWERS

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

BLUING LAYOUT

Dykem Co., 2307 N. 11th St., St. Louis 6, Mo.

BOLT and NUT MACHINES

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

BOLTS, NUTS AND SCREWS

Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

BOOKS, Technical

Industrial Press, 93 Worth St., New York 13, N. Y.

BORING BARS

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.

(Continued on page 252)

2 to 3 times Greater Thrust Capacity

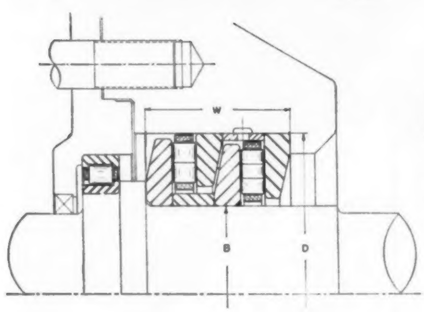
8 to 12 times Longer Life Expectancy

New ROLLWAY TANDEM THRUST BEARING

Using axial space along the shaft, rather than enlarging the housing diameter, this new Rollway tandem thrust bearing distributes the load over two or three stages of roller components. Gives 2 to 3 times more thrust capacity than conventional thrust bearings. Life expectancy is 8 to 12 times longer depending upon the number of stages.

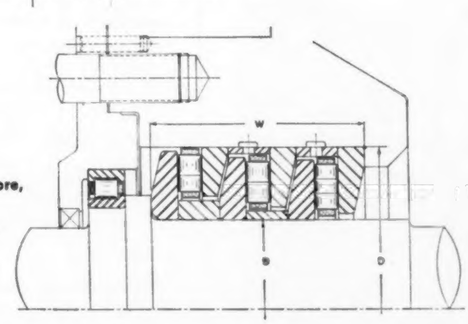
Each stage comprises a rotatable bearing plate . . . a bronze retainer with thru-hardened steel rollers . . . a compression sleeve . . . and a stationary bearing plate. The thrust load is applied to the first stage and is by-passed by each compression sleeve in turn to the remaining stage or stages.

Calculated deformation of the bearing plates distributes the load uniformly on all rollers. A greater number of rollers in the first stage carries about 60% of the load, without increasing the load per roller. Compression sleeves have cross-sectional areas proportional to the load imposed. Roller variance is held within one ten-thousandth inch.



✓ TWO STAGE TANDEM

22 sizes, up to 17" bore, 34" O.D., and 2,325,000 lb. capacity at 100 rpm



✓ THREE STAGE TANDEM

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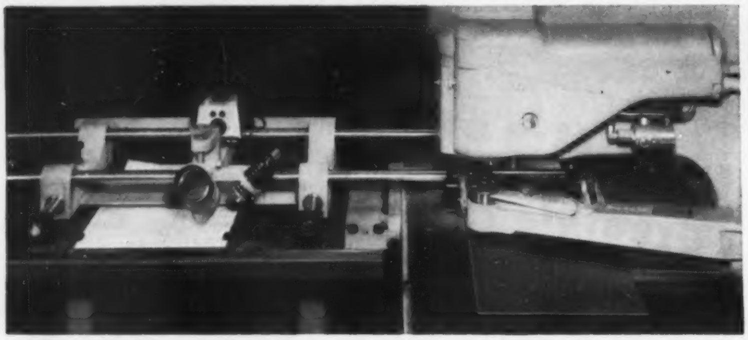

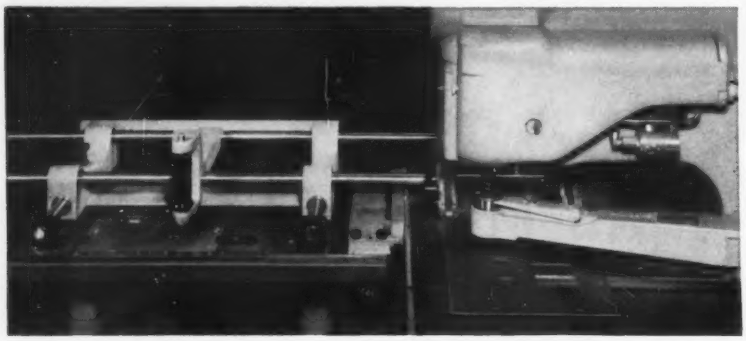

Universal Engineering Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Wesson Co., 120 Woodward Heights Blvd., Detroit 20, Mich.

BORING HEADS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N.Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wales-Strippit Co., Akron, N. Y.

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Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak. Mich.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain, Conn.

BORING MILLS, Vertical

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.

(Continued on page 254)

Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
New Britain Mch. Co., New Britain, Conn.

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American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
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American Broach & Mch. Co., Ann Arbor, Mich.
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Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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American Broach & Mch. Co., Ann Arbor, Mich.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati, Ohio.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE

American Brass Co., Waterbury 20, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Mueller Brass Co., Port Huron 35, Mich.

BRUSHES, Industrial, Tampico, Wire Wheel, Etc.

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

BUFFERS

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.

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Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Corbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel

Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

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DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

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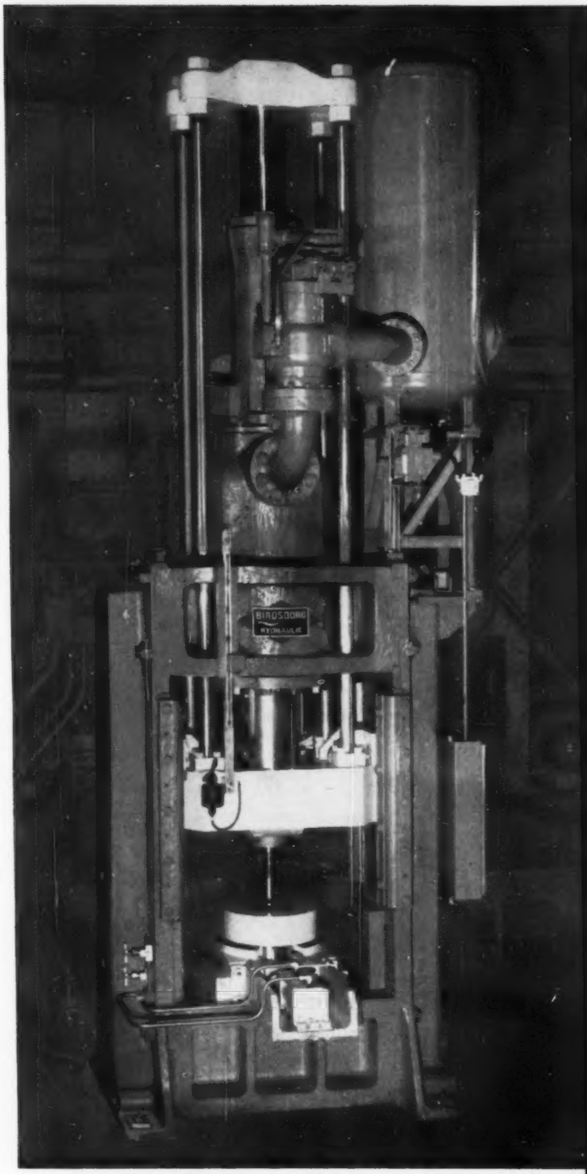
Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.



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Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS

Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

CARBIDES

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CASTINGS, Die

American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Pittsburgh Brass Mfg. Co., 3199 Penn Ave., Pittsburgh 1, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CASTINGS, Steel, Stainless, etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

CEMENT, Abrasive Disc

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

CENTER-DRILLING MACHINES

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
La Salle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe

Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Houston Grinding & Mfg. Co., Inc., Houston 8, Texas

Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKING MACHINES, Single-Spindle Automatic

Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter and Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated

Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cushman Chuck Co., 800 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

CHUCKS, Combination Universal-Independent

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Drill, Key Type

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Full Floating

Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Supreme Products, Inc., 2222 S. Calumet Ave., Chicago 16, Ill.

CHUCKS, Independent

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathes, etc.

Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

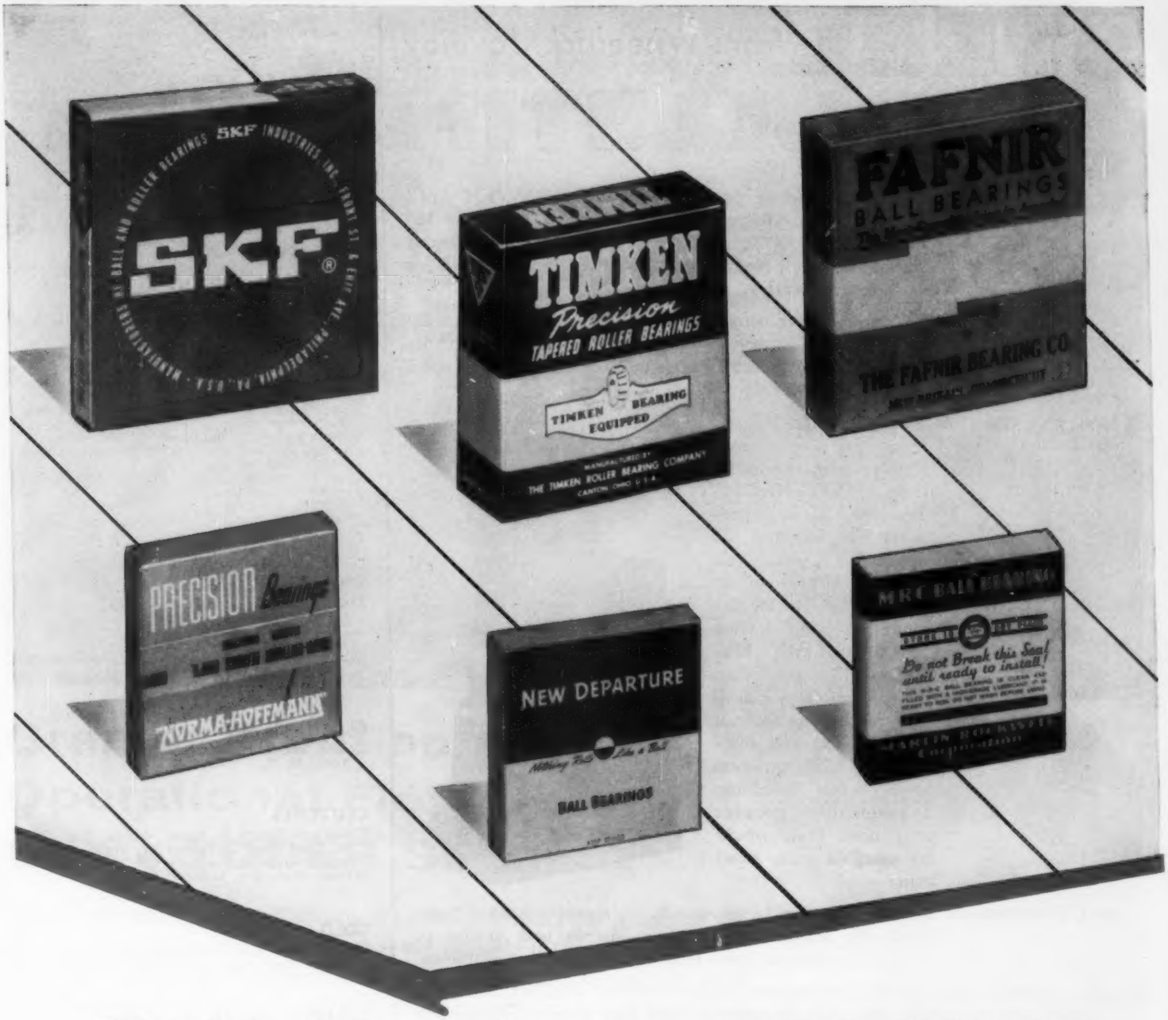
CHUCKS, Power Operated

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety

Jacobs Mfg. Co., West Hartford 10, Conn.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.

(Continued on page 262)



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Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

CHUCKS, Universal Three-Jaw

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless

Gisholt Mch. Co., Madison 10, Wis.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

CLEANERS, Metal

Oakite Products, Inc., 26 Rector St., New York, N. Y.

CLUTCHES

Cleveland Punch & Shear Works, Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Dynamatic Div. Eaton Mfg. Co., Kenosha, Wis.
Minster Mch. Co., Minster, Ohio.

COLD HEADING

Hassall, John, Inc., Westbury, L. I., N. Y.
National Machinery Co., Tiffin, Ohio

COLLETS—See Chucks, Collet

COLLOIDAL GRAPHITE

Acheson Colloids Co., 2150 Washington Ave., Port Huron, Mich.

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and Air

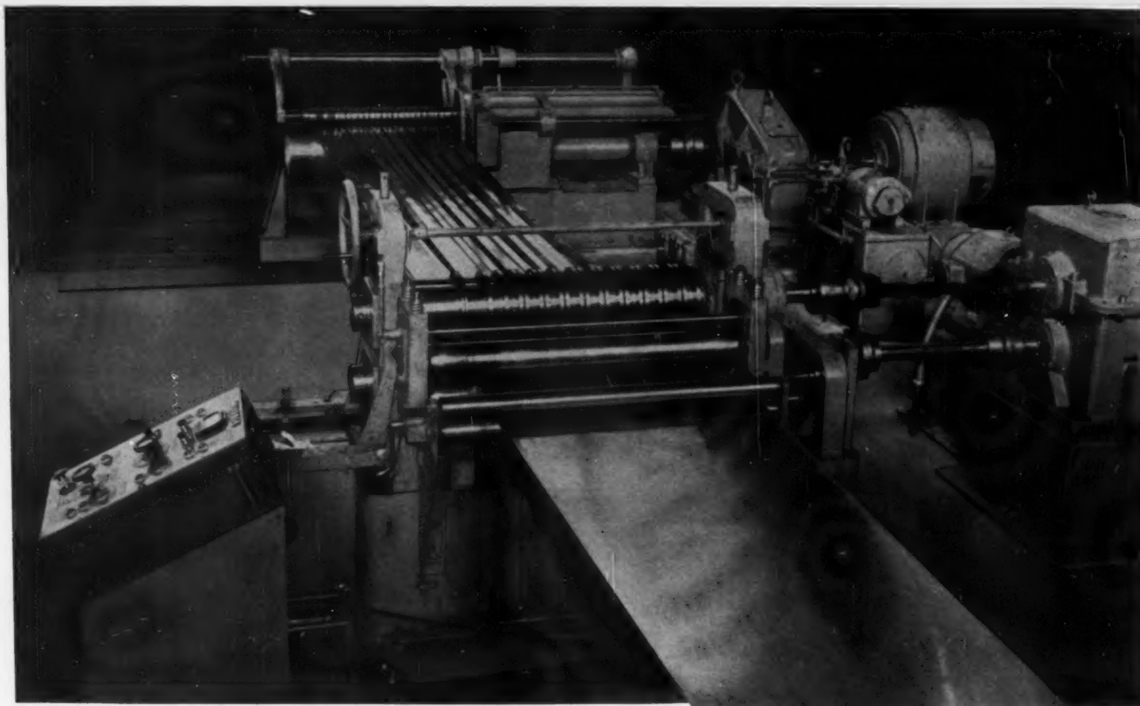
DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 883, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical

Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., 54 Laurel Ave., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

COMPOUNDS, Cleaning—See Cleaners, Metal

COMPOUNDS, Cutting, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids



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Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

CONTOUR FOLLOWER—See Tracing Attachments

CONTRACT WORK
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Van Keuren Co., Watertown, Mass.

CONTROLLERS
Allen-Bradley Co., 1331 S. 1st St., Milwaukee, Wis.

CONTROL SHAFTS—See Lead-screws & Splines, Ball Bearing

CONVEYORS FOR DUST, CHIPS, ETC.
Barnes, W. F. & John Co., Rockford, Ill.

COPPER
American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

COUNTERBORES AND COUNTERSINKS
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

COUNTERS
Starrett, The L. S., Co., Athol, Mass.

COUPLINGS
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

CUTTERS, Keyseating
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
DoAll Co., Des Plaines, Ill.
Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.
National Tw'st Drill & Tl. Co., Rochester, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CUTTERS, Milling
Apex Tool & Cutter Co., Inc., Shelton, Conn.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio.
National Twist Drill Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CUTTING AND GRINDING FLUIDS
Cincinnati Milling Products Div., Cincinnati, Ohio.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Cities Service Oil Co., 70 Pine St., New York, N. Y.
DoAll Co., Des Plaines, Ill.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

CUTTING-OFF MACHINES, Lathe Type

Bardons & Oliver, Inc., 1133 West Ninth St., Cleveland 13, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Cone Automatic Mch. Co., Windsor, Vt.
Modern Machine Tool Co., Jackson, Mich.

CUTTING-OFF SAWS, Abrasive Wheel

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

CUTTING TOOLS—See Tool Material

CYLINDERS, Air

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic

Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers, Inc., Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

DEBURRING MACHINES

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

DEMAGNETIZERS

Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Lufkin Rule Co., Saginaw, Mich.

DIE CASTINGS—See Casting, Die

DIE CASTING MACHINES

Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

DIE CUSHIONS

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago, Ill.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Minster Mch. Co., Minster, Ohio
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

DIE INSERTS, Carbide

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

DIE SETS AND DIEMAKERS' SUPPLIES

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Wales-Strippit Co., Akron, N. Y.

DIE SINKING MACHINES—See Milling Machines, Die Sinking, etc.

DIE STOCKS—See Stocks and Dies

DIES, Blanking, Forming, Drawing, Extruding, etc.

Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Ferracute Mch. Co., Bridgeton, N. J.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Olofsson Corp., Lansing, Mich.
Ryerson & Son, Inc., Jos. T., 16th & Rockwell St., Chicago 8, Ill.
Utz, Georg, Zurich, Switzerland
Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.
Wales-Strippit Corp., North Tonawanda, N. Y.

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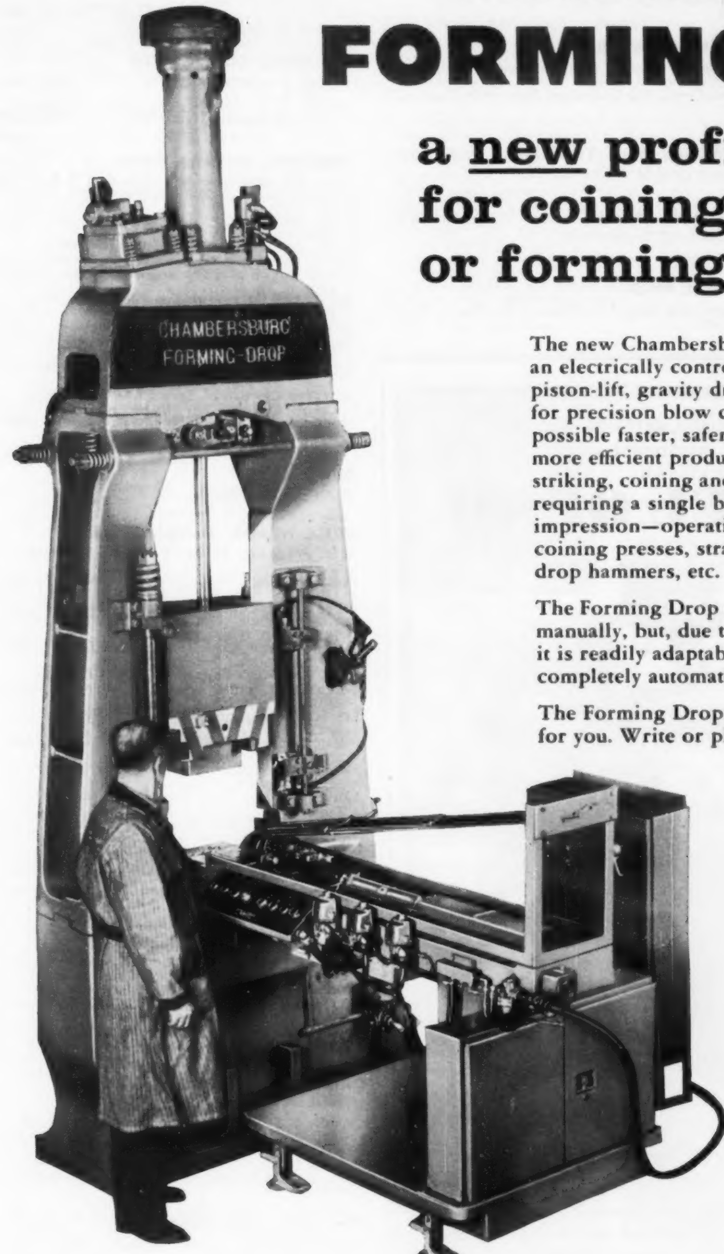

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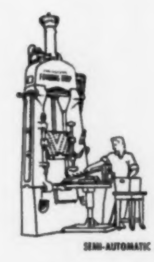

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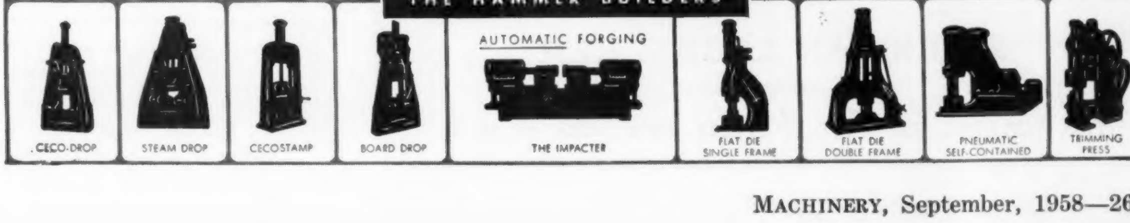

DIES, Lettering and Embossing
Wales-Strippit Corp., North Tonawanda, N. Y.

DIES, Self-opening Threading
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

DISINTEGRATORS
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.

DIVIDERS AND TRAMMELS—See Layout and Drafting Tools

DIVIDING HEADS—See Indexing and Spacing Equipment

DOWEL PINS
Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.

DoAll Co., Des Plaines, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

DRAWING COMPOUNDS
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.

DRESSERS, Grinding Wheel
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DRIFT KEYS
DoAll Co., Des Plaines, Ill.

DRILL HEADS, Multiple Spindle
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Delta Power Tool Div., 400 N. Lexington Ave., Milwaukee 10, Wis.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hartford Special Machinery Co., 387 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILL HEADS, Unit Type
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Snow Manufacturing Co., Bellwood, Illinois

DRILL SLEEVES AND EXTENSION HOLDERS
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Automatic Tool Co., Richmond, Ind.
National Twist Drill & Tool Co., Rochester, Mich.

DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

DRILLING AND BORING UNITS, Self-contained
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Leland-Gifford Co., Box 989, Worcester 1, Mass.

(Continued on page 269)

National Automatic Tool Co., S. 7th and N. Sts., Richmond, Ind.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Automatic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Edlund Mchry. Co. Div., Cortland, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Olofsson Corp., Lansing, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit Corp., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Bench

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.

DRILLING MACHINES, Deep Hole

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle

Baker Brothers Inc., 1000 Post Ave., Toledo 10. Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

DRILLING MACHINES, Radial

American Tool Works Co., Pearl and Eggleston Ave., Cincinnati, Ohio
Carlton Mch. Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

DRILLING MACHINES, Sensitive

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland 8, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Leland-Gifford Co., Box 989, Worcester, Mass.
Levin & Son, Inc., Louis, 3610 So. Broadway, Los Angeles, Calif.

(Continued on page 270)

National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Snow Manufacturing Co., Bellwood, Illinois
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Universal Radial
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

DRILLING MACHINES, Upright
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
LeMaire Tool & Mfg. Co., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit Corp., Akron, N. Y.

DRILLS, Center
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core
Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

DRILLS, Deep Hole, Gun
Ace Drill Corp., Adrian, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Oil Hole, Oil Tube
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

DRILLS, Portable pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

DRILLS, Ratchet
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DRILLS, Subland
Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tl. Co., Rochester, Mich.

DRILLS, Twist, High-Speed Steel, Carbon Steel
Ace Drill Corp., Adrian, Mich.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
Ace Drill Corp., Adrian, Michigan
Cleveland Twist Drill Co., Cleveland, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

ELECTRICAL DISCHARGE MACHINES
—See Disintegrators

ELECTRONIC CONTROL SYSTEMS
Electronic Control Systems, 2231 S. Barrington Ave., Los Angeles 64, Calif.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

EXPANDERS, Mechanical, Hydraulic
Grotnes Machine Wks., Inc., 5454 N. Walcott, Chicago 40, Illinois

EXTRACTORS, Screw
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis Boring Tool Div. Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FASTENERS
Allen Mfg Co., 133 Sheldon St., Hartford 2, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.

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Hassall, John Inc., Westbury, L. I., N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

FEEDERS, Automatic

Gear-O-Mation Div., Michigan Tool Co., 7171 McNichols Rd., Detroit 12, Mich.
V & O Press Co., Hudson, New York

FILES, Band

DoAll Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern

DoAll Co., Des Plaines, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

FILES AND BURRS, Rotary

DoAll Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES

Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

FLAME-HARDENING MACHINES

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FORGING HAMMERS, Steam and Air

Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses

Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

FORGING, Hollow-Bored

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron, Mich.

FORGINGS, Drop

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Ferrous, Aircraft and Missiles

Cameron Iron Works, Inc., 1000 Silber Rd., Houston, Tex.

FORGINGS, Press

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)

FORGINGS, Upset

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.

FORMING MACHINES, Cold-Rolling

Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.

(Continued on page 274)

why make parts the slow, costly way?

COLD-HEAD THEM!

Steel

Tappet plunger, splined square-head shaft, collar for adjustment wedge, universal joint bearing cup, pipe plug, spark plug body.

Copper

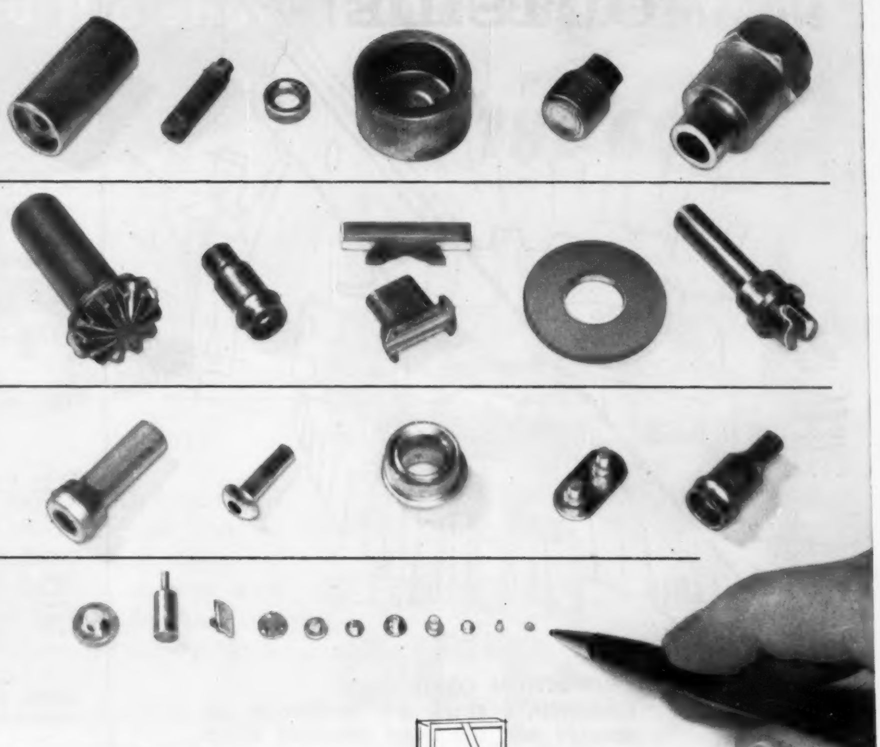
Ornamental stud, distributor cap center insert, commutator bar, wire clamp, solenoid contact, starter field terminal.

Aluminum

Hollow rivet, blind rivet, flanged collar, link, distributor cap outside insert.

Precious Metals

Electrical contact, transistor case, miscellaneous rivets and electrical contacts.



Of various metals, the parts identified above were developed for fast, accurate production on National Cold Headers.

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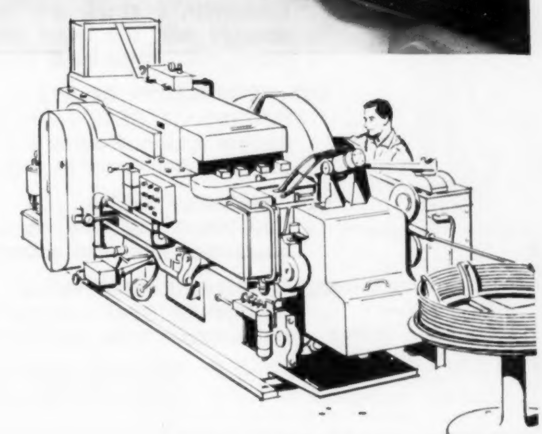

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NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD DETROIT CHICAGO

Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

FORMING MACHINES, Multiple-slide
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Baldwin-Lima- Hamilton Corp., Lima-Hamilton Div., Hamilton, Ohio
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65 St., Chicago 38, Ill.
Dreis & Krump Mfg. Co., 7416 Loomis Blvd., Chicago 36, Ill.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co., Providence, R. I.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

GAGE BLOCKS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Automatic Sorting
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.
Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Lufkin Rule Co., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.

GAGES, Electric Comparator
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Grinding
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness
Brown & Sharpe Mfg. Co., Providence, R. I.

GAGES, Multiple Inspection
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

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GAGES, Plug and Ring

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Van Keuren Co., Watertown, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap

Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness

DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

GEAR BURNISHERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Bevel and Spiral

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS

American Schiess Corp., 1232 Penn. Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

GEAR HONERS

National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.

GEAR MOTORS—See Speed Reducers

GEAR RACKS

Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio

GEAR SHAPERS

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS

Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefedorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio

(*Continued on page 278*)

Horsburgh & Scott Co., 5114 Hamilton Ave., Cleveland 14, Ohio
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
James D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

GENERATORS, Electric

Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

GRADUATING MACHINES

Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

GRINDERS, Die and Mold

Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich. (also drill point thinner)
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

GRINDERS, Face Mill

Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear

Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Precise Products Corp., 3751 Blue River Rd., Racine, Wis.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Madison-Kipp Corp., Madison, Wis.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, 8. Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach

Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co. 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GRINDING MACHINES, Centerless

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GRINDING MACHINES, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

GRINDING MACHINES, Disc

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

American Laubscher Corp., Fisk Bldg., 250 W. 57 St., New York 19, N. Y.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 4, Mich.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDING MACHINES, Surface Rotary

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Majestic, Inc., 147 Joseph Campau, Detroit, Mich.

GRINDING WHEEL DRESSING AND FORMING DEVICES

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Bay State Abrasive Co., Westboro, Mass.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cincinnati Milling Products Div., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Gardner Machine Co., Beloit, Wis.
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.

GROOVING TOOLS, Internal

Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Portable Pneumatic

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HAMMERS, Power

Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.

(Continued on page 280)

Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.
Wilson Mechanical Instrument Div., 230 Park Ave., New York 17, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HOISTS, Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Jes-Cal Co., Fraser, Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.

HONING STONES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Jes-Cal Co., Fraser, Michigan
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE

American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment

Baldwin-Lima Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.

Watson-Stillman Co., 565 Blossom Rd., Rochester 10, N. Y.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

HYDRAULIC POWER UNITS OR TOOL HEADS

Barnes Drill Co., 814 Chestnut, Rockford 3, Ill.
Barnes, W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Specicl Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Austin Industrial Corp., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool C., 2531 11th St., Rockford, Ill.
Vinco Corp., 9111 Schaefer Highway, Detroit, Mich.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, L. S. Co., Athol, Mass.

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Co., Providence, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Lufkin Rule Co., Saginaw, Mich.
National Automatic Tool Co., S. 7th - N. Sts., Richmond, Ind.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Starrett The L. S., Co., Athol, Mass.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The, L. S., Co., Athol, Mass.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.
Watson Stillman Co., 565 Blossom Rd., Rochester 10, N. Y.

JACKS, Planer—See Set-up Equipment

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIG and FIXTURE PARTS

Northwestern Tools, Inc., 117 Hollier Ave., Dayton 3, Ohio

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.

LAPPING MACHINES

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Do-All Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

LATHE ATTACHMENTS

Atlas Press Co., Kalamazoo, Mich.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Levin, Louis & Son, Los Angeles 21, Calif.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft

Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mcn. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Sidney Machine Tool Co., Sidney, Ohio

LATHES, Engine, Manufacturing

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Engine, Toolroom

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Leblond, R. K. Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Gap

Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio

LATHES, Hollow Spindle

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Roll

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton Ohio
Bliss, E. W., Co., Canton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Speed, Second-operation

Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., Cincinnati 25, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic

Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES, Turret, Ram Type, Saddle Type

Atlas Press Co., Kalamazoo, Mich.
Bardons & Oliver Inc., Ft. W. 9th St., Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Levin & Son, Inc., Louis, Los Angeles 8, Calif.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Co., Athol, Mass.

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LEVELS
Lufkin Rule Co., Saginaw, Mich.
Starrett, The L. S., Co., Athol, Mass.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Bearings, Inc., 3634 Euclid Ave., Cleveland 15, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
Stuart D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

LUBRICATING SYSTEMS
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave. Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.

MACHINERY, Used and Rebuilt
Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry Co., 2025 E. Genessee Ave., Saginaw, Mich.
Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The, L. S., Co., Athol, Mass.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Gorton Mch. Co., 1321 Racine St., Racine Wis.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lufkin Rule Co., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Van Keuren Co., Watertown 72, Mass.

MEASURING WIRES—Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown 72, Mass

MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George, Co., Inc., 200 Lafayette St. New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.
Van Keuren Co., Watertown 72, Mass.

MICROSCOPES, Toolmakers'
Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

MILLING MACHINE ATTACHMENTS
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches, Inc., 4701 Marburg Ave., Cincinnati 9 Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave.,

MILLING MACHINES, Automatic
Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Nichols, W. H. Co., Waltham 54, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St. and Girard Ave., Philadelphia, Pa.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bench, Hand

Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Nichols, W. H. Co., Waltham 54, Mass.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Arrow Engineering Co., 120 E. Market St., Indianapolis, Ind .
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Colonial-Romulus Div., Parkgrove Station, Detroit 5, Mich.
Consolidated Mch. Tool Div.. Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St. Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Atlas Press Co., Kalamazoo, Mich.
Austin Industrial Corp., 76 Mamaroneck Ave., White Plains. N. Y.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

MILLING MACHINES, Planer Type

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sunstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Kearney & Trecher Corp., 6784 W. National, Milwaukee, 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Air

Ingersoll-Rand Co., Phillipsburg, N. J.

MOTORS, Electric

Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Lincoln Electric Co., Cleveland 17, Ohio
Reliance Electric & Engineering Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

MOTORS, Hydraulic

Barnes, J. S., Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Oilgear Co., 1569 W. Pierce St.; Milwaukee, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers, Inc., Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE-STATION MACHINES, Dial Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
National Automatic Tool Co., S. 7th N. St. Richmond, Ind.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Mch. Co., Cincinnati 9, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago 38, Ill.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
La Salle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sundstrand Mch., Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9399 S. Kenwood Ave., Chicago 19, Ill.

NIBBLING MACHINES

Wales-Strippit Corp., Akron, N. Y.

NUT SETTERS—See Screwdrivers, etc.

NUTS—See Bolts, Nuts and Screws

OIL GROOVERS

Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

OILERS AND LUBRICATORS

Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Ill.
Madison-Kipp Corp., Madison, Wis.
Wicaco Mch. Corp., Philadelphia, Pa.

OILS, CUTTING SOLUBLE—See Cutting and Grinding Fluids

OILS, Lubricating—See Lubricating Oils and Greases

OILS, Quenching and Tempering

Cities Service Oil Co., 70 Pine St., New York, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 - 5th Ave., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago 80, Il.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

OPTICAL FLATS

Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Van Keuren Co., Watertown 72, Mass.

PACKING, Leather, Metal, Rubber Asbestos, Etc.

Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

PAINTING EQUIPMENT, Spray—See Spraying Equipment, Metal

PARALLELS

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Starrett, The L. S., Co., Athol, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, Wood and Metal

Mummert-Dixon Co., Hanover, Pa.

PIPE, Steel, Stainless, etc.

Alleghany Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co. (Tubular Prod. Div.) Beaver Falls, Penna.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

PIPE AND TUBING MILLS, Electric-weld

Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

PIPE AND TUBING, Brass and Copper

American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.

PIPE THREADING AND CUTTING MACHINES

Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Landis Machine Co., Inc., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio

PLANER JACKS—See Set-up Equipment

PLANERS, Double Housing and Openside

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton Ohio
Consolidated Mch. Tool Div., Rochester, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A. Co., 3611 Woodburn Ave., Cincinnati, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

PLASTICS AND PLASTIC PRODUCTS

Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
Gisholt Mch. Co., Madison, Wis.
U. S. Steel Corp., Nat'l Tube Div., Pittsburgh, Pa.

PRESS BRAKES—See Brakes, Press and Bending

PRESS FEEDER, Automatic

Bliss E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Nilson, A. H. Machine Co., Bridgeport, Conn.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

PRESSES, Arbor

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha Wis.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.
Wilson K. R., Inc., Arcade, N. Y.

PRESSES, Assembling

Alva Allen Industries, Clinton, Missouri
Bliss E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Blanking, Stamping

Alva Allen Industries, Clinton, Missouri
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E. Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
V. & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Walsh Press & Die Co., 4709 W. Kinzie St., Chicago 44, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Briquetting

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Closed-Die Forging

Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Coining, Embossing

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W. Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E. Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.

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Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R. Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Die Sinking (Hobbing)

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Die Tryout

Bliss, E. W. Co., 1375 Raff Rd., S. W. Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Drawing

Alva Allen Industries, Clinton, Missouri
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6399 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Foot

Famco Machine Co., Kenosha, Wis.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Notching

Alva Allen Industries, Clinton, Missouri
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit Corp., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing

Alva Allen Industries, Clinton, Missouri
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Famco Machine Co., Kenosha, Wis.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood, Chicago 19, Ill.
Wales-Strippit Co., Akron, N. Y.
Walsh Press & Die Co., 4709 W. Kinzie St., Chicago 44, Ill.
Wiedemann Machine Co., Gulph Rd., King of Prussia, Penna.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Quenching

Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Rubber-Forming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Trimming

Alva Allen Industries, Clinton, Missouri
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Dake Corp., 604 Monroe St., Grand Haven, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Farquhar, A. B. Div., 142 N. Duke St., York, Penna.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

PROTECTORS, Thread & Tube

Maybrun, A. E. Co., 920 Ripley St., Santa Rosa, Calif.

PULLEYS

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

PUMPS, Coolant and Lubricant

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Graymills Co., 3705 N. Lincoln Ave., Evanston, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Little Giant Pump Co., 5101 Classen Blvd., Oklahoma City 18, Oklahoma
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio
Viking Pump Co., Cedar Falls, Iowa

PUMPS, Hydraulic

American Engineering Co., Wheatsheaf Lane & Sepviva St., Philadelphia 37, Penna.
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Viking Pump Co., Cedar Falls, Iowa
Wilson, K. R., Inc., Arcade, N. Y.

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PUNCHES AND DIES—See Dies, Blanking, etc.

REAMERS, Rose, Chucking, Jobbers Taper, Shell, Adjustable, etc.

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
National Twist Drill & Tool Co., Rochester, Mich.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

REELS, Stock

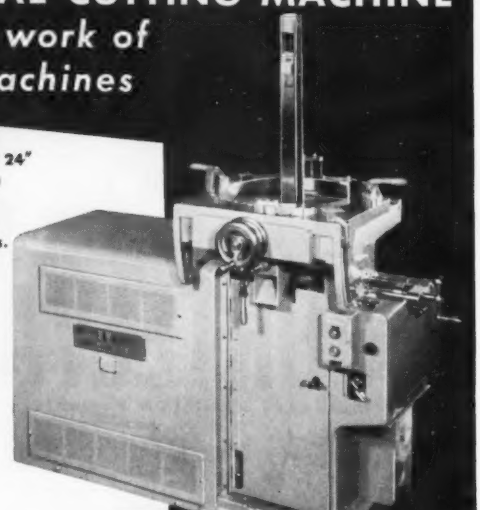
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

REFRACTORS Heat-Treating Furnaces

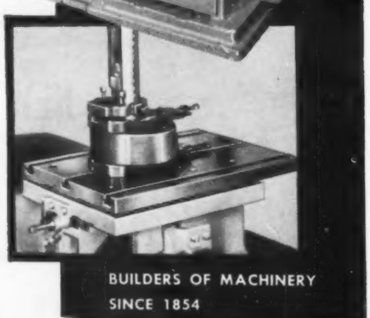
Norton Co., 1 New Bond St., Worcester 6, Mass.

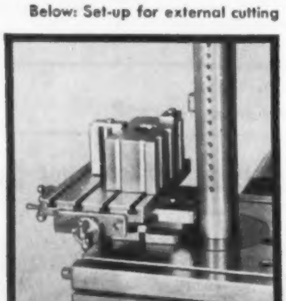
RETAINING RINGS FOR BEARINGS, etc.

Bearings, Inc., 3634 Euclid Ave., Cleveland, Ohio
Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.



Right: Set-up for internal cutting
Below: Set-up for external cutting





RIVETERS, Portable

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

RIVETERS, Stationary

Brown & Sharpe Mfg. Co., 35 Promenade St., Providence 1, R. I.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

ROTARY TABLES, Optical

Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Michigan

RULES, SCALES AND STRAIGHTEDGES
See Machinists' Small Tools

RUST INHIBITORS

Kosenit Co., Mahwah, N. J.
Oakite Products, Inc., 26 Rector St., New York, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

SAND BLAST EQUIPMENT—See Blast Cleaning Equipment

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Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Mach. Works, Philadelphia, Pa.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Starrett, The L. S., Co., Athol, Mass.

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DoAll Co., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

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SAWING MACHINES, Band

Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Cutron Mfg. Co., Lubbock, Texas
Delta Power Tool Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Famco Machine Co., Kenosha, Wis.

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DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

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Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

SAWS, Screw-slotting—See Cutters, Milling

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Cleco Air Tools, P. O. Box 2119, Houston, Texas
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
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Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.

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SCREW MACHINES, Single-Spindle Automatic

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Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain- Gridlev Mch. Div., New Britain, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

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Cone Automatic Mch. Co., Inc., Windsor, Vt.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
National Acme Co., 170 E. 31st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Warner & Swasey, 6701 Carnegie Ave., Cleveland 3, Ohio

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Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

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Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave. Chicago, Illinois

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Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

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Northwestern Tools, Inc., 117 Hollier Ave., Dayton 3, Ohio
Starrett, The L. S., Co., Athol, Mass.

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Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

SHAPERS, Vertical and Slotters

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Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

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Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio

SHEARS, Rotary
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Simonds Saw & Steel Co. (Knives), 470 Main St., Fitchburg, Mass.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Famco Machine Co., Kenosha, Wis.
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SHIM STOCK
Laminated Shim Co., Inc., Glenbrook, Conn.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

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Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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SOCKETS—See Drill Sleeves and Extension Holders

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Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
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Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 835 Green St., Ann Arbor, Mich.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
Coulter, James, Machine Co., Bridgeport 5, Conn.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
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Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
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Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Kingsbury Mch. Tool Corp., Keene, N. H.
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
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Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
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National Twist Drill & Tool Co., Rochester, Mich.
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Sheffield Corp., Box 893, Dayton 1, Ohio
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James D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
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Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N. St., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio

SPRAYING EQUIPMENT, Metal

Metallizing Eng. Co., Westbury, L. I., N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal

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Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

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Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
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Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

STRAIGHTEDGES—See Machinists' Small Tools

STRAIGHTENERS, Flat Stock and Wire

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Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

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Bethlehem Steel Co., Bethlehem, Pa.
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STRIP AND SHEET, Non-ferrous

American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.

(Continued on page 294)

Bridgeport Brass Co., Bridgeport, Conn.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRUCTURAL SHAPES

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DoAll Co., Des Plaines, Ill.

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National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
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Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
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Sheffield Corp., Box 893, Dayton 1, Ohio

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Sheffield Corp., Box 893, Dayton 1, Ohio

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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
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Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
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Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Vascoloy-Ramet Corp., Waukegan, Ill.

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DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel

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Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

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Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit Co., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio

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TRANSMISSION, Variable Speed

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Boston Gear Wks., Quincy, Mass.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
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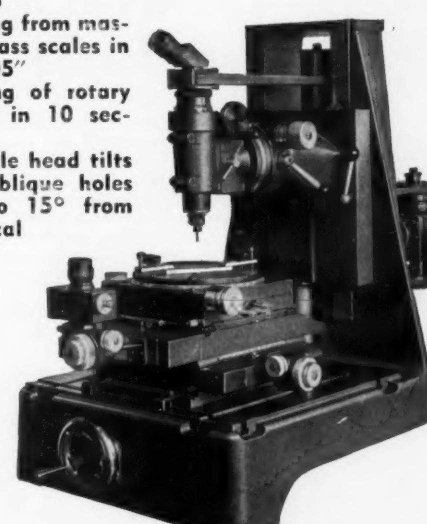

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Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
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Babcock & Wilcox Co., Beaver Falls, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio

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Vickers, Inc., Detroit 32, Mich.

VALVES, Air
Hunt, C. B., & Son, Inc., 1911 E. Pershing St., Salem, Ohio
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Numatics, Inc., Milford, Mich.
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

VALVES, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hunt, C. B., & Son, 1911 E. Pershing St., Salem, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Logansport Machine, Inc., 810 Center Ave., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio
Delta Power Tool Div., Rockwell Mfg. Co., 400 N. Lexington Ave. Pittsburgh, Pa.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
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Universal Engineering Co., Frankenmuth 2, Mich.
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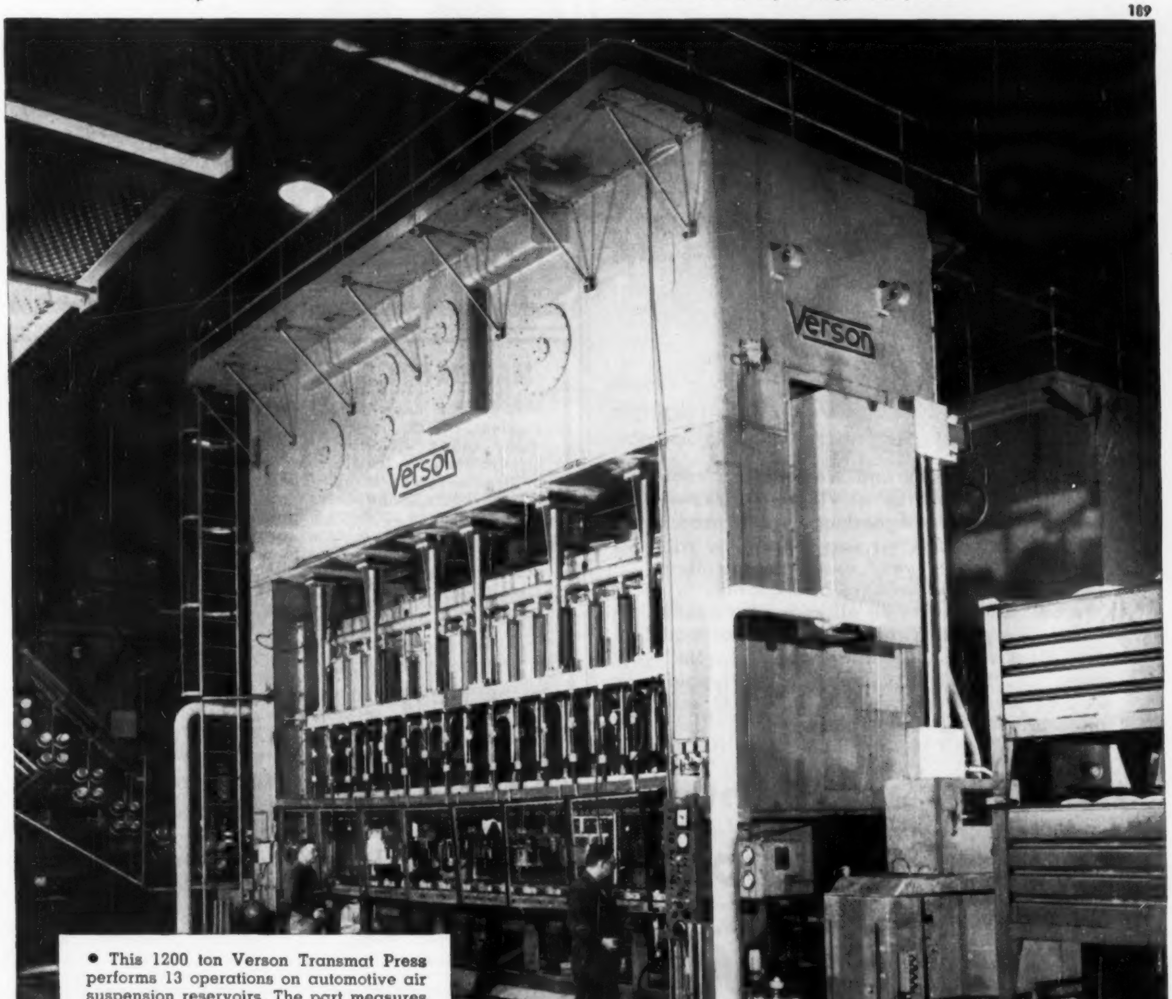

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27"x48" centers LeBlond, m.d.
27"x120" centers LeBlond, m.d., 1944
27"x168" centers LeBlond, m.d.
27"x41' centers Niles, p.r.t., 1944
30"x76" centers Niles-Bement-Pond, m.d., taper
32"x23' centers Boye & Emmes, m.d.
42"x31' 1⅛" centers, American, H.D., m.d.
54"x174" centers Houston, Stanwood & Gamble, Heavy Type, m.d.

MANUFACTURING LATHES

12x33", 20"x25" Jones & Lamson Fay Automatic Lathes, 1944
No. 3 Lodge & Shipley Duomatic, m.d., late type
No. 3A Lodge & Shipley Duomatic, m.d.
No. 4 R.K. LeBlond Boring Lathe, 37" bed, 4" hole, m.d., latest
No. 9, 12 LeBlond Multi-Cut, m.d.
No. 16 LeBlond Automatic, m.d.
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11x18" LeBlond Rapid Production, m.d.
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12x18" Reid Small Piece Production, Model 6WSL, m.d.
Model U, 14"x24" centers, LoSwing, m.d.
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No. 9WSL, Reid Production, m.d.
17"x75¾" LeBlond, m.d.
No. 10 Sundstrand Automatic Production, m.d.
No. 12 Sundstrand Automatic Production, m.d.
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Lipe Semi-Automatic Carbo Lathe, m.d.
13"x12⅛" centers LeBlond H.D. Rapid Production, m.d.
Model B1 Blunt Speed Lathe
Colburn Mfg. Bench Type Speed Lathe, m.d.
Model NA2B Schauer Speed Lath
Cri-Dan, Type B, Semi-Automatic H.S., single point threading Machine, new
10x20" centers Hi-Turn, new

HAND MILLERS

No. 1M Kent-Owens, m.d., late

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No. 08 Cincinnati, rise and fall, 1944
No. 000 Brown & Sharpe Plain Production, m.d.
No. MM-1-6 U.S. Multi-Miller, m.d.
No. 33H Sundstrand Trimplex Rigidmill, m.d.
No. 3A Sundstrand Plain Automatic Rigidmill, m.d.
24" Cincinnati Duplex Automatic, m.d.
48"x16' Newton Slab Miller, m.d.
54"x30"x16' Ingersoll Slab Miller, m.d.
Model 1402 Kearney & Trecker Simplex, m.d., Production
Model 1404 Kearney & Trecker Simplex, m.d., Production
No. 12 Brown & Sharpe Plain Horizontal, m.d.
3—24" Cincinnati Plain Hydromatic, m.d. in base
3—36" Cincinnati Duplex Hydromatic, m.d. in base
No. 4-36 Cincinnati Plain Hydromatic, m.d.
Model 33-1536 Sundstrand Simplex Fluid Screw Type Rigidmill, m.d.
No. 34-36 Cincinnati Semi-Special Plain Hydromatic, tracer control
28"x144" Cincinnati Plain Hydromatic, m.d., late
56-96 Cincinnati Plain Hydromatic, m.d. in base, 1944
56-72 Cincinnati Hydromatic Production, 1946

PLAIN MILLING MACHINES

No. 1B Milwaukee, m.d. in rear
No. 2 Cincinnati H.P., m.d.
No. 2MH Cincinnati, m.d.
No. 2K Kearney & Trecker, m.d.
No. 2B Brown & Sharpe, m.d.
No. 3B Brown & Sharpe, m.d.
No. 3B Milwaukee, m.d.
No. 3 Cincinnati Plain Medium Speed, Dial Type, m.d.
No. 3 SP Van Norman, m.d.
No. 3 G. S. Hendey Plain, m.d.
No. 4 Cincinnati Plain H.P., m.d.
No. 4B Brown & Sharpe, m.d.
No. 5 Cincinnati H.P., m.d., late
No. 2LP Van Norman, m.d.

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No. 1-14 Kent Owens, m.d.
No. 2H Kearney & Trecker, m.d.
No. 2K Kearney & Trecker, m.d.
No. 3VG Reed Prentice Vertical Miller & Die Sinking Machine, m.d.
No. 4 Cincinnati H.S., Dial Type, m.d.
No. 4K Kearney & Trecker, m.d.
No. 40 W. B. Knight, m.d.
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30"x30"x10' Cincinnati, belted m.d., 2 heads
36"x36"x8' Cincinnati, m.d., 2 heads on rail
36"x36"x10' Cincinnati Openside, D.C. reversing m.d.
36"x36"12' Betts, m.d., 3 heads
36"x36"x12' G. A. Gray, 2 heads
36"x36"x18' table Cincinnati Double Housing, m.d.
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36"x36"x20' G. A. Gray Extra Heavy, belt, 2 heads on rail
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48"x48"x18' Niles-Bement-Pond, 2 heads, belt
48"x48"x28' Cincinnati, reversing m.d., 4 heads
56"x42"x14' Cincinnati, belt drive, 2 heads

PROFILERS

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No. 12M Morey, 2 spindle m.d., 1943
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GRINDERS, CYL. 4" x 12" No. H Landis, 1943
GRINDERS, UNIV. 14" x 14" Mod. 112 Rivett
GRINDERS, CYL. 20" x 72" Landis, 1943
GRINDER, INT. 72A5 Heald, Univ., Hydr.
GRINDER, INT. No. 74 Heald Hydr., plain, 1941
GRINDER, SURF. 14" x 48" Mattison, 1942
GRINDER, SURF. 20" & 24" No. 25A Heald,
GRINDER, SURF. 36" No. 18 Blanchard, 1940
GRINDER, CUTTER. 30" Ingersoll, 1942
GRINDER, CARBIDE. Nos. 48 and 49 Excello, 1941
GRINDER, RADIUS. No. 49 VanNorman, late
HOB SHARPENER. Type HRS Barber Colman
KELLER. BL2416 Pratt & Whitney 3 Spdl., 1941
LATHE, ENGINE. 14" South Bend, late
LATHES, ENGINE. 13", 15" & 17" LeBlond Regals, new
MILLER, AUTO. 48" No. 33 Sundstrand
MILLER, HAND. No. 2RV Kent-Owens, 1942
MILLERS. No. 10 & 3 VanNorman Duplex
MILLER, UNIVERSAL. No. 2H Kerney & Trecker, H.S.D.T.
MILLER, PLAIN. No. 2 Cincinnati
MILLER, VERTICAL. No. 2 Brown & Sharpe, 1943
OIL GROOVER. Wicaco Continuous, 1943
MILLER. No. 36 VanNorman, ram type 1942
ROUTERS. Type A-1R Onsrud Radial 84", late
SAW. 6" x 6" No. 6 Marvel Hack, late
SAW. 10" x 10" Racine Hydr. Hack, 1941
SHAPER. 6" P&W vert.
SHAPER. 36" Rockford, open side
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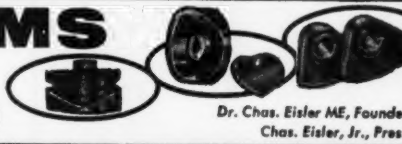

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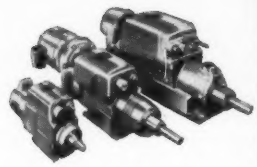
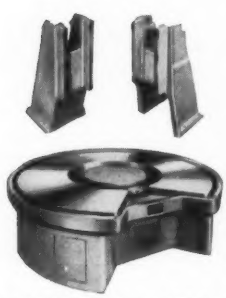
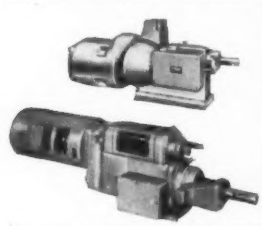


Air Hydraulic Drill Units



Circular Machine Base and Columns



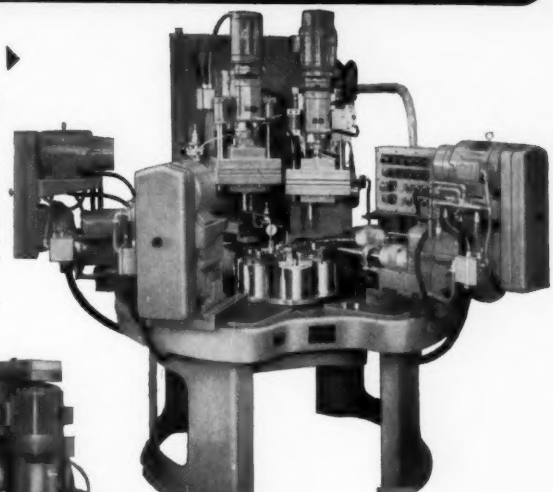
Automatic Lead Screw Tapping Units

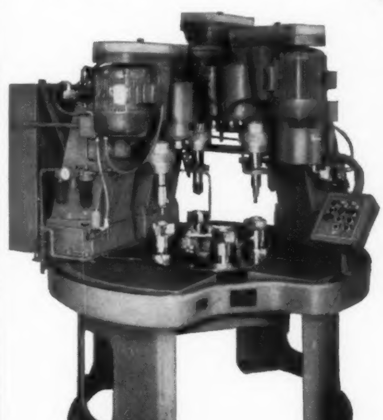
Rectangular Machine Base

EXAMPLE*

A high speed indexing machine to drill and lead screw tap horizontal opposed pipe ports and two vertical mounting holes in stainless steel valve bodies at 320 parts per hour. Standard automatic self-centering Skinner air chucks hold parts.

Photo courtesy of The Skinner Chuck Company





EXAMPLE*

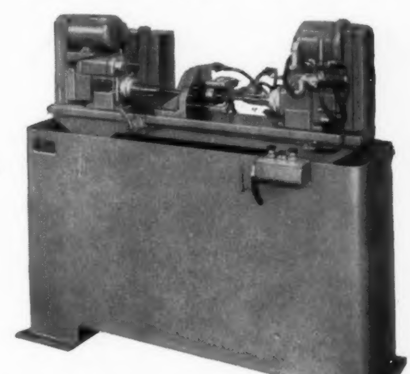
Combination drill, bore and face plus two tapping operations in die cast regulator valve spring cages. Capacity: 450 parts per hour.

Photo courtesy of Watts Regulator Company

EXAMPLE*

Double end opposed combination ream and face die cast piston plates to close tolerance. Simplified air-manual fixture loading permits production of 423 parts per hour.

Photo courtesy of Bendix Products Division Bendix Aviation Corporation



***Note**

The above examples illustrate single-purpose machine cost savings through use of standard pre-engineered components. The components, bases, columns, adapters and units as shown, are available for machines built by you or for you from Hartford Special.

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